U.S. Congress.
Marine and Fisheries

NATIONAL MARINE SCIENCES PROGRAM

PART 1

HEARINGS

BEFORE THE

SUBCOMMITTEE ON OCEANOGRAPHY

OF THE

COMMITTEE ON
MERCHANT MARINE AND FISHERIES
HOUSE OF REPRESENTATIVES

NINETIETH CONGRESS

FIRST SESSION

ON

IMPLEMENTATION OF THE NATIONAL MARINE SCIENCES PROGRAM

AUGUST 17, 24, SEPTEMBER 14, 19, 20, 21, 22, OCTOBER 12, AND DECEMBER 7, 8, 11, AND 12, 1967

Serial No. 90–19

Printed for the use of the
Committee on Merchant Marine and Fisheries

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NATIONAL MARINE SCIENCES PROGRAM

THURSDAY, AUGUST 17, 1967

House of Representatives,
Subcommittee on Oceanography of the
Committee on Merchant Marine and Fisheries,
Washington, D.C.

The subcommittee met at 10:10 a.m., pursuant to call, in room 1334, Longworth House Office Building, Hon. Alton Lennon (chairman of the subcommittee) presiding.

Mr. Lennon. The meeting will please come to order.

As the first order of business this morning, I want to recognize in the audience a distinguished scientist, a former consultant to the Oceanography Subcommittee, Capt. Paul Bauer. Captain, we are delighted to have you with us this morning.

Captain Bauer. Thank you, Mr. Chairman.

Mr. Lennon. This morning we are holding the first of a series of hearings on the status of our national marine sciences program.

A little over a year ago, as all of you will recall, the Marine Resources and Engineering Development Act of 1966 was enacted after several years of what we believed to be very thorough and comprehensive study. That act set forth a declaration of national policy and national objectives for a long-range program. Key features of the act, designed to implement its far-reaching objectives, were the establishment of a National Council on Marine Resources and Engineering Development and the establishment of a Commission on Marine Science, Engineering, and Resources.

This Council, with the Vice President as its Chairman, and eight Cabinet-level members, is responsible under the law and under the act that we referred to for advising and assisting the President in all aspects of current marine science activities of the Federal Government.

The Commission, on the other hand, composed of 15 members appointed by the President, not more than five of whom are from the Federal Government, is responsible and specifically charged under the act for developing a long-range marine science program for the future.

One year ago today, the Council on Marine Resources and Engineering Development came into being. It is their anniversary. It is, therefore, I think, particularly significant that these hearings should begin today with the executive secretary, the distinguished Dr. Edward Wenk, Jr., to testify on behalf of the Council.

We believe the Council and the new Commission have had sufficient time to begin implementation of the law and gain functional experience under it. Therefore, we commence these hearings with the thought that our committee should be brought up to date on developments in the national marine science program.

I might say that some of you will recall that there was a difference of opinion with respect to creating by this act a so-called National Council. There was some apprehension on the part of the administration that it would be repetitious if the individuals designated by those appointed to the Council at the Cabinet level would be the same individuals who have comparable or similar positions under the White House program for marine sciences.

I want to make this public statement here now that through the inspiring leadership and, I think, dedication and complete interest under the Chairman of that Council, Vice President Humphrey, we have seen a new order and a new day. I have been privileged to communicate both by letter and by personal contact with Dr. Wenk and the Vice President, and I know that each meeting of the Council has been well attended by the members of the Council or someone at a responsible level attending as their designee.

They have done, in my judgment and in the judgment of those of us on the subcommittee, Mr. Mosher primarily, the ranking minority member of this subcommittee, a very fine and excellent service to this great field that we are talking about today. I might say for the benefit of those who are not privileged to participate as members of the Advisory Committee to the National Committee, to which Mr. Mosher and I were designated by the Speaker and ultimately appointed by the President as observers in an advisory capacity, that in the meetings that we have attended of the Commission which meets here on a monthly basis in Washington, as well as other places in the country, we have been tremendously impressed by the leadership of the Chairman of that Commission, Dr. Stratton, a former president of MIT, a former dean at MIT, a former professor at MIT, and now the chairman of the Ford Foundation.

He has provided, in our judgment, a significant organizational leadership genius, and we are delighted with the manner and the method and the way that they are proceeding.

I would like to say, too, that shortly after the act was signed, which I recollect was on June 17 of last year, I wrote to the President and suggested to him that the caliber, the knowledge, the interest, the concern and time that could be given by the members of the Commission that he might see fit to appoint would determine the success of the ultimate report to the Congress, and to the President of the United States.

He has in his consideration and appointment of the Commission selected a wide view of the most knowledgeable, interested, and dedicated people I know in these fields that we are here to discuss today.

Now, unfortunately, we do apologize to Dr. Wenk and his associates of the Council and I don't think they have to be reminded of the fact that when a Member of Congress goes to his office at 8 or 8:30 in the morning or as late as 9, we are immediately involved in long-distance telephone conversations. As I tried to get over here a large group of constituents walked into the office. You just can't say, "Good morning, how do you do," because they come to see us.

Of course, there are conflicts also of other subcommittees meeting this morning. I think you already know that the House is scheduled to go in at 11 o'clock. That decision was not made until rather late last night. We are trying to get permission to continue our hearings during the session of the House, which we have to get by unanimous consent on the House floor.

We anticipate that there will be a quorum call at least by 11:15 to 11:25, but if we secure permission of the House, we will return to resume the hearings and continue as long as is possible.

I might say, too, that it is the plan of the subcommittee not to consider itself an oversight committee, but we do intend to bring to the committee here in the course of these hearings the agencies and the departments and bureaus that are participating dollarwise or otherwise in the oceanography and in the broad aspects and spectrum of the marine sciences. We anticipate that in September when the Commission meets again that we will hear from the Commission. We have that assurance.

So at this time I would like to call our first witness, a friend, a distinguished scientist, Dr. Edward Wenk, Jr., whom all of you know as the Executive Secretary of the National Council on Marine Resources and Engineering Development.

Dr. Wenk, we welcome you again aboard. You have been before this committee a number of times. We are delighted to have you and your associates.

STATEMENT OF DR. EDWARD WENK, JR., EXECUTIVE SECRETARY, NATIONAL COUNCIL ON MARINE RESOURCES AND ENGINEERING DEVELOPMENT

Dr. Wenk. Thank you very much, Mr. Chairman and members of the committee.

I wonder if I might, first, present to you a letter from the Vice President of the United States that I would like to read in the course of my testimony in response to your very kind invitation for information to be provided on activities of the Council.

Mr. Lennon. All right. Dr. Wenk, it is your purpose to read it shortly after you get into your statement and then, of course, it will be made officially a part of the record. I appreciate the formal presentation.

I have had the privilege of reading it and I am very grateful for the Vice President's interest and concern and dedication in this field. You may proceed, sir.

Dr. Wenk. Thank you very much, Mr. Chairman.

I am indeed honored by this opportunity to testify before your committee and to report on steps taken by the administration to implement the Marine Resources and Engineering Development Act of 1966. Your chairman invited Vice President Humphrey, as Chairman of the National Council on Marine Resources and Engineering Development, to present a summary of the Council's activities in carrying out provisions of the legislation this past year.

I am appearing at the request of the Vice President, who is unable to appear personally. With your permission, Mr. Chairman, I should like to read the Vice President's letter of reply.

THE VICE PRESIDENT,
Washington, August 16, 1967.

HON. ALTON LENNON,
Chairman, Subcommittee on Oceanography,
Committee on Merchant Marine and Fisheries,
U.S. House of Representatives, Washington, D.C.

DEAR MR. CHAIRMAN: As Chairman of the National Council on Marine Resources and Engineering Development, I am pleased to respond to your invitation to review progress of the Federal Government during the past year toward implementation of the Marine Resources and Engineering Development Act.

The legislation was developed almost entirely through Congressional initiative and this first year of operating experience has confirmed the soundness of the organic Act, Public Law 89–454, and the amendment that established Sea Grant Colleges and Programs.

Shortly after signing Public Law 89–454, the President asked me to activate the Council and assume the statutory responsibility to advise and assist him in marine science affairs. The Council met first on August 17—exactly one year ago today—and has convened six times since that date. The President asked not only for action, but for immediate action. He requested that the Council review the recommendations of his Science Advisory Committee for more effective utilization of the sea and to submit both budget and legislative recommendations that could be embodied in his FY 1968 program. He also assigned to the Council the responsibility of preparing the annual report describing Federal marine science activities and budgets.

The President's initial recommendations set forth in his report to the Congress in March reflect our awareness that the benefits of the sea can and must increasingly serve the needs of our growing and increasingly urbanized society—the needs for food, minerals, energy, and recreation; for commerce and economic growth; and for strengthened national security and improved international understanding.

Let me briefly review some of these challenges that face our Nation and the world today:

There are one and one-half billion hungry people in the world. The full food potential of the seas, seriously neglected in the past, must be realized to combat famine and despair. Technologies now at hand can be directed toward increasing the world's fishing catch and enriching the diets of the underfed.

Seventy-five percent of our population lives along our coasts and Great Lakes. Nine of our fifteen largest metropolitan areas are on the oceans and Great Lakes and three are on ocean tributaries. Twenty million children live in these metropolitan areas within sight of potential water recreation areas but are often denied their use. Only three percent of our ocean and Great Lakes coastline has been set aside for public use or conservation.

More than 90 percent by value of our intercontinental commerce travels by ship. Although there have been rapid changes in the character of ocean cargoes and technologies of cargo handling, the average age of our port structures is 45 years and the average age of our merchant ships is 19 years.

The continuing threats to world peace require our Navy to maintain a high level of readiness and versatility through a sea based deterrent and undersea warfare capability. Middle East conflicts following closure of the Gulf of Aqaba vividly emphasize the urgent need for a strengthened code of international law of the sea.

Thirty million Americans swim in the oceans, eleven million are saltwater sport fishermen, and eight million engage in recreational boating in our coastal States, yet industrial wastes being dumped into ocean tributaries will increase seven-fold by the year 2000 unless there are drastic changes in waste handling.

Ocean-generated storms cause millions of dollars of damage annually along our coasts, but marine weather warning services are available to less than one-third of our coastal areas.

During the past year I have discussed these challenges with scientists, engineers, business leaders, and local, State, and Federal officials here in Washington, at oceanographic installations in nine coastal states, and in the capitals of six countries of Western Europe and one in Asia.

The problems of the sea are complex, and they involve every type of concern and institution that exists on the landward side of the shoreline. Thus, we must solicit the varied ideas, the advice, and the participation of universities, industry, and all elements of government, just as we have found this mixture an essential ingredient for the vitality and progress of our Nation on shore.

For seven years, the Congress and the scientific community have insisted on more intensive action to reap the benefits of the sea. Now the Administration is responding to the Congressional mandate—building on long-standing capabilities within eleven Federal departments and agencies and accelerating our progress with a new enthusiasm and determination, a new sense of direction and momentum. We are:

—identifying goals, and milestones to reach these goals
—setting priorities

—developing purposeful programs to bring our ocean interests into balance with our overall national interests
—clarifying agency responsibilities to develop individual and collective capabilities
—mobilizing our resources—Government, academic, and individual

We singled out a number of marine science areas for particular emphasis during FY 1968, and by concentrating diverse projects on a selected number of objectives have begun to obtain a greater effect from a still modest enterprise. We are critically examining the opportunities for FY 1969, realizing that current actions will significantly affect the course we chart during the next several years.

Certain of these programs are the responsibility of a single agency; but increasingly, new programs cross agency lines. The Council is taking steps to prevent unnecessary duplication and to ensure that program gaps do not occur.

We are fortunate to have a close association with the advisory Commission on Marine Science, Engineering, and Resources. While the Commission and the Council are independent, we are at the same time working harmoniously together toward common goals. We are looking forward to the Commission's recommendations to the President and to the Congress concerning a national plan and the most appropriate future structure of the Federal Government to carry out statuory purposes.

Most of the mysteries of the sea remain cloaked before us. Most of its resources remain untapped. Most of its potential to serve national goals remains unawakened. To realize this opportunity depends on a creative partnership of our Federal Government with States, with universities and research organizations, and with industry.

We also look forward to increased activities by other Nations with whom we seek further international cooperation and collaboration—in scientific research and in a framework of law by which the sea may serve all men.

Pure logic and practical economics dictate this program. However, not to be forgotten is man's compelling desire to explore and to understand the world around him. The spirit which has carried us to rugged mountain peaks, remote polar icecaps, and distant reaches of outerspace now propels us to the ocean deeps. This spirit is fortified with a confidence developed by past contributions of science that we will not only conquer the ocean deeps but will use them in satisfying the needs of our society.

In concluding, may I say how much I welcome this continuing interest by the Congress in what is both an enormously complex set of issues and an untapped set of opportunities to study and utilize the sea to serve man. This is a program that has support by both Executive and Legislative branches of Government, free of partisan controversy, and I look forward to our working further with the Congress in serving our mutual interests.

Sincerely,

HUBERT H. HUMPHREY.

Dr. WENK. Mr. Chairman, the Vice President's letter establishes the broad perspective of the administration's concepts and goals for intensified activities associated with the sea. He has dealt with the question: "Why accelerate marine science and technology?"

I should like to supplement this perspective with discussion of two questions: "What has the Federal Government done this past year in formulating policies and plans?" and "How does the Council assist the President in their formulation?"

The point of departure is the legislative mandate that for the first time in U.S. history established an explicit national policy to develop, encourage, and maintain a coordinated, comprehensive, and long-range national program in marine sciences for the benefit of mankind. Although both the Council and Commission that were established to facilitate implementation of the act have statutory termination dates, your declaration of purpose and the assignment of responsibility to the President do not have termination dates.

In my view, this legislation marks a turning point in our Nation's interests in the sea. It recognizes that previous investments in the quest for scientific knowledge have borne fruit and that we should intensify efforts to utilize marine resources more deliberately and to strengthen ocean-based industries to serve our national purpose.

During the past 6 years this Nation developed world leadership in scientific achievements, an unexcelled fleet of research ships and laboratory facilities, and a vigorous base of professional talent. Now we seek to apply these capabilities to the broad purposes of our Nation—to the economic, political, and social goals that transcend the geographic demarcation between land and water.

Expressed another way, since man's problems do not stop at the water's edge, neither should the solutions. Thus, we find in marine science affairs the same diversity and complexity of scientific disciplines and techniques, the wide range of activities and institutions that characterize man's activities on land.

These concern national security; maritime transportation; development of fishery resources; minerals, oil, and gas; urban redevelopment; recreation; pollution abatement and control; health and safety; expansion of man's knowledge about his own environment; domestic economic growth; foreign economic development; and international cooperation and collaboration.

It is thus not surprising that marine science activities evolved historically in 29 bureaus of 11 different Federal departments and agencies and are of direct interest to a number of different congressional committees; numerous State, regional, and international organizations; many universities; and a wide variety of industries.

This new legislation provided a coherent purpose to this diversity of activity, institutions, and competing interests that derive a unity from a common marine environment. The act also established a clear focus for national leadership. No new operating agency was established. Pending completion of studies now underway, the present Federal agency structure is continued, with responsibility for overall policy planning and coordination placed in the Office of the President, with advice and assistance of the Council.

I am pleased to report that as one consequence of the legislation each Federal agency has reviewed its own programs, its internal priorities and its internal machinery—both to be more responsive to the goals set forth by the new mandate, and to articulate its activities with those of sister agencies more harmoniously.

Since this committee intends to receive additional testimony from officials of these agencies, I shall defer to them for details as to their administrative actions and programs. At the same time, the agencies are endeavoring to meet these goals, individually they are working collectively through the Council.

In accordance with the legislation, the Council is composed of five Cabinet officers and three department and agency heads having significant maritime-related activities. The Vice President has invited as observers: the Directors of the Bureau of the Budget, and of the Office of Science and Technology; the Chairman of the Council of Economic Advisers; the Administrator of NASA; the Secretary of the Smithsonian Institution; and the Administrator of the Agency for International Development.

The role of the Council is to assist the President by identifying Government-wide issues, by evaluating alternative policies, and by formulating a balanced and consistent set of marine science priorities and programs. As the letter of the Vice President mentioned, the Council has thus begun to—

delineate marine science activies in relation to national goals;

develop a comprehensive program to be conducted by 11 Federal departments independently or in cooperation with States, academic institutions, and industry;

designate and fix agency responsibilities and facilitate cooperation among Federal agencies;

examine appropriate roles for public and private investment;

undertake legal studies of problems arising out of the management, recovery, and control of marine resources; and

initiate long-range studies of the potential benefits of marine science activities to the U.S. economy, security, health, and welfare.

Implementation is entirely the responsibility of the operating agencies, but the Council seeks to assist them to build on existing strengths in every way possible. When missions cross agency lines however, the Council may designate one of the agencies as a lead agency to assume responsibility for interagency planning and coordination.

The President's first major assignment to the Council was to request recommendations for the fiscal year 1968 budget. Nine areas were isolated for special emphasis and these are set forth in the President's first report on marine sciences that is before you.

They concern—

a new food-from-the-sea program as part of the war on hunger, including overseas demonstration projects utilizing fish protein concentrate:

immediate implementation of the sea grant program to strengthen education, applied research, and information transfer;

a new study for improved collection and dissemination of oceanographic data;

designation of the Chesapeake Bay as a model to study the effects of estuarine pollution and remedial measures;

a pilot plan for offshore minerals exploration:

an expanded ocean observation system to improve nearshore weather prediction for small boats and oil facilities and accuracy of long-range forecasting;

a strengthened program of deep ocean technology especially to develop a future capability to recover lost equipment;

a new ship to accelerate research in sub-Arctic waters; and

programs for international cooperation to promote peaceful use of the oceans.

To place these priority efforts in perspective, the Government's total activities in marine science and technology have also been examined and the total recommended to the Congress for fiscal year 1968 is $462 million, up 13 percent from fiscal year 1967. These funds are the minimum necessary to expand efforts to understand the sea and develop its resources; to enhance capabilities of local government, universities, and private industry to join in this vital enterprise.

Detailed tables of funding are presented in the President's report—categorized by agency, by function, and by public purpose. These details aid our internal program planning and are intended also to assist appropriation subcommittees of the Congress to determine how the marine elements of separate agency programs relate to our overall efforts.

This $462 million, incidentally, represents less than 3 percent of the $17 billion proposed for fiscal year 1968 for Federal research and development across the board. Considering the wide variety of purposes these funds must serve, we have endeavored this first year to improve overall effectiveness by deploying existing capabilities around a limited number of objectives.

We are doing this by—

1. utilizing fully all the resources currently engaged in various facets of oceanography, public, and private;
2. developing policies and coordinating programs to attain maximum effectiveness without sacrificing distinctive imagination and initiative of each participant;
3. inviting fresh ideas from all sectors of our society; and
4. fostering collaboration between Federal, State, and local entities; between the United States and other countries; and between public and private sectors.

The nine new initiatives that were identified earlier amount to $41 million of the $53 million increase requested for this year over last. Most of the initiatives are now awaiting final review by the appropriate committees of the Congress.

Let me elaborate on the scope and content of several of these initiatives to illustrate how we have selected maritime activities which contribute to national goals, and how programs and agency responsibilities were developed.

The problem of a world population that out-paces food production impinges critically on our Nation's interest and it is to that end that the United States has a longstanding policy to wage war on hunger.

Every possible approach is required to correct world protein deficiency. The food-from-the-sea program is a new effort to bring fish protein to undernourished people. The fisheries potential of the sea as a protein source has been recognized for many years, and it now provides a new opportunity for the United States to provide world leadership in combating one of the most compelling problems facing mankind.

This program is a plan for action that could be developed promptly and economically, with available or emerging technologies and within the framework of existing institutions. It should also upgrade and assist domestic fisheries and fish processing industries through the development of markets for species not now commercially caught and for new products, and by an expanded knowledge of the fishery stocks of the world oceans.

First steps already begun involve feasibility studies of fishing and marketing potential overseas, to be followed by demonstration projects on a bilateral cooperative basis with other nations utilizing fish protein concentrate. The Agency for International Development has been designated as a lead agency, with the Bureau of Commercial Fisheries developing the necessary technology. Other Federal agencies will assist.

In short, the demonstration program will help to improve commercial processes for production of FPC, improve fish catching, landing, and processing capabilities of protein deficient countries, develop markets, and establish a viable commercial FPC system in at least one country.

Also, other nations and private interests will be encouraged to expand upon this demonstration program wherever feasible.

A second area of increased emphasis relates to the capability of our Navy to operate in the deep oceans. This initiative must be considered in the broader perspective that defense will continue to present a major requirement for ocean sciences and engineering. Such requirements anticipate that future strategic forces are likely to rely heavily on ocean-based systems and that we need to continue updating antisubmarine capabilities. Both operations are intrinsically limited by the understanding of environmental conditions which affect performance of surveillance sensors and weapons systems.

Operations at great depths are related to broad defense objectives. Both the loss of the *Thresher* and the more recent loss and recovery of an unarmed nuclear weapon near Spain revealed limitations of our deep ocean engineering capability. Current Navy efforts in deep submergence are thus being strengthened both for the recovery of lost equipment and to provide a general deep ocean engineering capability.

A third area concerns upgrading of the Nation's oceanographic data system. The rational flow of information from collector to consumer is the lifeblood of marine research. If intensified but necessarily dispersed efforts are to be successful—to understand complex ocean phenomena, marine life and the ocean-atmosphere interaction—and if understanding is to foster application, data handling must be responsive to a wide variety of user needs.

The marine sciences information system involves connected functions of data acquisition, standardization, tests for accuracy, storage, retrieval, analysis, and synthesis. Studies have shown that the Nation's oceanographic data handling processes can be considerably improved. The Council took action authorizing its staff to undertake a comprehensive study of oceanographic data requirements and management steps that can meet a wide variety of user needs.

The study is being conducted primarily on a contract, with funds contributed by various Federal agencies. The initial phase was begun this June. A second major phase will be initiated around the first of the year.

A fourth area of special emphasis derives from the National Sea Grant College and Program Act of 1966. This legislation is aimed at advancing education, training, applied research and information transfer—in phase with accomplishment of the overall purpose of a viable marine sciences activity.

The National Science Foundation is administering the program. The Marine Sciences Council, however, is called upon by the legislation to advise and assist the Foundation with respect to sea grant policies, procedures, and operations.

The Council fulfilled this responsibility last fall, and took two actions. It adopted as an area of special emphasis the immediate implementation of the Sea Grant Act and, second, went on to establish—in partnership with the Foundation—a broad set of criteria as policy guidance set forth in the President's marine sciences report.

As a final example of our areas of special emphasis the Council recommended utilization of a proposed replacement vessel for the ice patrol in subpolar oceanographic research. This particular research field has been somewhat neglected. It requires special instruments and ice traversing capabilities. The Coast Guard proposed that the replacement ship for the overage "Evergreen" could simultaneously be equipped as a specialized vessel for work in these regions while serving its patrol functions. This particular item has encountered some difficulties in the Appropriations Committee, and I know I speak for the Vice President and the entire Council in expressing our appreciation, Mr. Chairman, for your personal support and that of your committee in statements on the floor that explained the importance of this program.

Since formulating these fiscal year 1968 recommendations, the Council has gone on to study a number of separate policy and program issues. Those made public concern such matters as the marine resources resolution introduced last fall at the United National General Assembly calling for examination by the Secretary General of international marine science activities:

> initiatives for Latin American cooperation announced by President Johnson at Punte del Este;
>
> a joint study by the Departments of Interior and Transportation concerning *Torrey Canyon*-type pollution incidents;
>
> a recommendation that the Navy's transit satellite system be made available for oceanographic and commercial ships and that the Department of Transportation be assigned responsibility to develop plans for an updated national navigation plan for civilian use.

In accordance with terms of the legislation, the Council has initiated a number of legal studies to analyze the current framework of international and domestic law that affects sovereignty on the seas and development of their resources. We are examining implications of possible changes to such legal regimes as they would help serve our national interest by advancing the objectives of the act.

We are now looking ahead to the next fiscal year. As the Vice President noted, the proposals under study will affect the future course and speed of the Nation's program in marine sciences almost for the next 2 years.

In the international area, we are considering how other nations may join the United States with funds and manpower for joint exploration of the sea. Both the developing and the developed nations can contribute and benefit from these activities. We are examining which programs can best be conducted in concert with other nations and whether individual programs should be on a bilateral or multilateral basis.

We are considering the appropriate role of the Federal Government in relation to States. In fact, Mr. Chairman, we are placing special emphasis on this question of how to participate with the individual States and regions in the United States, to look at their local problems. We have detected a widespread and spontaneous surge of local initiative and we are looking at means by which these areas may analyze their special problems and coordinate their local interests with those of the Federal Government.

We are examining Government-industry roles and relationships, especially to encourage private initiative to develop resources on public lands of the Continental Shelf.

The Council Secretariat has begun study of long-range needs and steps for their prompt achievement. To use the best talent this country has to offer, a number of small contracts has also been awarded. Problem areas being studied include:

1. *Fishing technology.*—Will technical and economic problems of the fishing industry yield to systems analysis to illuminate directions for strengthening the existing industry? What elements in the entire fishing cycle can be modified to provide the greatest return for the research dollar?

2. *Aquiculture.*—What existing practices, worldwide, have proven successful, and what research and engineering are needed to advance such activities in the United States and abroad?

3. *Space observations.*—How may special capabilities of orbiting spacecraft be employed to enhance observation of marine phenomena to aid precise navigation and location, and to interrogate sensors mounted on buoys and other platforms?

4. *Harbor development.*—What are the technical, economic, political, and sociological problems which plague harbor and port development, and for which marine science and technology might provide solutions?

5. *Multiple use of the shoreline.*—What are the current and projected patterns of land use along our estuaries, coasts, and Great Lakes? How do these conflict? What technological and legal steps will provide optimum employment of scarce land and water resources?

6. *Projected resource supply and demand.*—What is our current inventory of the offshore resources on our Continental Shelves? What gaps in the inventory warrant intensive mapping? What are the differences in costs of solid mineral, oil, and gas recovery onshore versus offshore and what technological factors account for the differences in costs? Which areas would yield to intensified research, and who should do it?

7. *Hazards.*—What are the hazards to safety of life and to property from offshore operations, from shipping, from oil and mineral exploitation? What steps should be taken to provide standards, regulations, and enforcement in the public interest?

8. *Transfer of technology.*—How can applications of space technology and other advanced technologies to marine science activities be accelerated in regard to sensors, compact powerplants, metallurgy and materials, microminiaturization, and knowledge of human behavior and physiology under conditions of stress?

9. *Incentives for private investment.*—What mechanisms of the Federal Government have been employed in the past to encourage private investment in the public interest? How have they succeeded or failed? Which are needed to accelerate marine development?

10. *Basic research and manpower, finally, and very importantly*—What are the long-range manpower needs in marine sciences? What training and educational facilities are needed, onshore and at sea? What special fellowships are required to accommodate those who wish to switch fields at a graduate level? What are the long-term needs of our Nation's oceanographic research laboratories, and what immediate steps are required to assure continued U.S. leadership in this area and to provide a sound base for applied research and development?

Before concluding, I should like to review very briefly how the Council operates as a board of advisers to develop recommendations for the President. Issues and action alternatives are based on working papers brought before the Council by the Council Secretariat. These may be initiated in one of the member agencies, through outside studies, or by Council staff.

Advice and new ideas are also solicited from authorities in various fields who serve as consultants, from the many varied groups of our marine sciences community such as the National Academy of Sciences, National Academy of Engineering, numerous professional groups, and Governors and State planning officials. Assistance during the past year has also been provided by the Interagency Committee on Oceanography, which had been made available by the Chairman of its parent, the Federal Council for Science and Technology.

Where policy or program activities cross agency lines, and are of continuing nature, it has been desirable to develop proposals for Council action through a committee structure. These have been established by the Vice President on a selected basis as the minimum necessary to achieve purposes of the Council. These committees concern—

1. Marine research, education, and facilities;
2. International affairs;
3. Exploration and environmental prediction services;
4. Multiple uses of the seashore; and
5. Food from the sea.

The Council is also looking to the Commission as a source of advice both from the entire body and from its individual members.

To summarize, last summer this Nation embarked on a unification of purpose to explore the last geographically unknown territory on our planet. Although quite different from past exploration, this activity has goals, it anticipates the mobilization of ideas, capital, men, and leadership for accomplishment of purposes as challenging as any ancient expedition to the New World or future landing on the moon.

We are endeavoring to understand the role of the oceans in our national thinking, to find new maritime solutions to some of the old pervasive problems of famine, of threats to world order, of problems in a growing and increasingly urbanized population.

The Federal Government's program can be regarded as the sum of its parts. But with Presidential and Vice Presidential leadership to develop goals and provide a new momentum to the overall effort, to minimize effects of duplication, and especially to take advantage of fresh ideals that may have in the past fallen in the gaps between agencies, we are striving to make the total effort more than the previous sum of the parts.

We are beginning to sharpen the tools for this purpose, to utilize the advanced technology associated with a highly industrialized society; to develop the manpower and mobilize resources for a comprehensive, ocean-based program; to establish a framework of law that will facilitate work on the Continental Shelf and in the deep oceans.

To this end, we seek to expand knowledge of the marine environment and intensify development of its resources, by drawing together as partners Government, industry, and the academic community that have proven such a strong, vibrant team in the development of this Nation's present status as a world power.

At the same time, we are earnestly considering how intensified studies and use of the sea may serve as bridges for cooperation and for understanding among all nations.

This is a difficult, complex task. We have, however, begun.

Mr. LENNON. Dr. Wenk, I commented earlier that in my judgment it was a very wise decision made by the two legislative committees of the House and Senate, which was finally collaborated in by the executive branch of the Government, to establish the National Council and I have commented earlier that I thought it had done an excellent job and was proceeding precisely in the manner and in the way that the legislative intent of the Congress indicated.

I think most of the members and I am sure all of them agree with me that your statement here this morning corroborates and substantiates my earlier statement with respect to that. I noticed, Dr. Wenk, that you indicated here that the President had appointed five Cabinet members, I believe, to the Council.

It is on page 4:

> In accordance with the legislation, the Council is composed of five Cabinet officers * * *.

Dr. WENK. These, Mr. Chairman, are provided for by the legislation; I was endeavoring to elaborate on the eight that you had referred to in your opening statement.

Mr. LENNON. In reading subsection (a) of section 3 of the Public Law 89–454, we note that this Council shall be composed of:

> (1) The Vice President, who shall be Chairman of the Council, (2) The Secretary of State, (3) The Secretary of the Navy, (4) The Secretary of the Interior, (5) The Secretary of Commerce, (6) The Chairman of the Atomic Energy Commission, (7) The Director of the National Science Foundation, (8) The Secretary of Health, Education, and Welfare, (9) The Secretary of the Treasury.

Six Cabinet officers that are named in the bill and I wonder if that was a typographical error in your statement when you said there were five Cabinet officers. Apparently the legislation provided for what is accepted as six Cabinet officers named in the legislation.

Would you comment on that?

Dr. WENK. Mr. Chairman, the Secretary of State, the Secretary of the Interior, the Secretary of Commerce, Secretary of HEW—and now as a consequence of the transfer of the Coast Guard to the Department of Transportation, the Secretary of Transportation, rather than the Secretary of Treasury—are five Cabinet officers referred to in my own presentation. I regarded the Secretary of Navy, the Chairman of the Atomic Energy Commission, and the Director of the National Science Foundation as the three department and agency heads.

Mr. LENNON. For the record, Doctor, subsection (b) of section 3 provides that:

> The President may name to the Council such other officers and officials as he deems advisable.

Skipping down to subsection (d):

> Each member of the Council, except those designated pursuant to subsection (b), may designate any officer of his department or agency appointed with the advice and consent of the Senate to serve on the Council as his alternate in his unavoidable absence.

Now if we return to subsection (b) of section 3, would you furnish for the record the names and the positions of any other persons that the President has appointed to the Council since the law gives him that discretion?

Dr. WENK. Up until this time, Mr. Chairman, the President has named no additional officers as members of the Council. There are, however, many other agencies of Government having an interest in the programs that warrant their continued presence. As a consequence, though, not provided for in the legislation, the Vice President as Chairman has invited them to serve as observers. I am pleased to report to you that their attendance has been just as diligent as that of the members themselves, even though they don't enjoy that status of a legislatively designated position on the Council.

Mr. LENNON. It has been my understanding that in the seven meetings that you have had in this past year, starting a year ago today when you had your first organizational meeting of the Council, you have had splendid attendance and I have attempted to communicate that information to the other members of the subcommittee.

I have great enthusiasm for the Council based on the attendance and the interest that has been demonstrated in the seven Council meetings. Would you comment on that, because I want the members of the subcommittee to have the same enthusiasm that I have for what the Council is trying to do and is doing?

Dr. WENK. Mr. Chairman, your earlier comment is quite accurate regarding the attendance by the members designated by the legislation. In cases of their absence they have been represented by senior policy officials as provided for in the act, in practically all cases by the No. 2 man in the department.

The attendance by some of the members has been 100 percent. I would be pleased to provide you for the record, if you wish, a list of those who have attended these meetings, because I think it reinforces your point.

Mr. LENNON. I would appreciate that, Doctor, if you would, because since this is the beginning of a series of hearings and it is my judgment that properly we should have the Council first, if you would furnish those people by name and title and designation, representing the Cabinet level and those others who may have attended, I think it would be of interest for future reading.

(Attendance by members or alternates at meetings of the National Council on Marine Resources and Engineering Development, August 17, 1966–July 13, 1967:)

AUGUST 17, 1966

Members Attending

The Vice President.
The Honorable George W. Ball, Undersecretary of State.
The Honorable Henry Fowler, Secretary of Treasury.
The Honorable John T. Connor, Secretary of Commerce.
The Honorable Paul Nitze, Secretary of Navy.
The Honorable Stanley Cain, Assistant Secretary of Interior.
Dr. George A. Silver, Deputy Assistant Secretary of Health, Education and Welfare.
The Honorable Glenn T. Seaborg, Chairman, Atomic Energy Commission.
The Honorable Leland J. Haworth, Director, National Science Foundation.
The Honorable Edward Wenk, Jr., Executive Secretary.
Six other observers and guests of policy rank.

SEPTEMBER 19, 1966

Members Attending

The Vice President.
The Honorable Paul Nitze, Secretary of the Navy.
The Honorable John Gardner, Secretary of Health, Education and Welfare.
The Honorable Leland J. Haworth, Director, National Science Foundation.
The Honorable George Ball, Undersecretary of State.
The Honorable Stanley Cain, Assistant Secretary of Interior.
The Honorable J. Herbert Holloman, Assistant Secretary of Commerce.
The Honorable Gerald Tape, Commissioner, Atomic Energy Commission.
Admiral Willard J. Smith, Commandant, U.S. Coast Guard.
The Honorable Edward Wenk, Jr., Executive Secretary.
Five other observers and guests of policy rank.

OCTOBER 27, 1966

Members Attending

The Vice President.
The Honorable Paul Nitze, Secretary of the Navy.
The Honorable John Gardner, Secretary of Health, Education and Welfare.
The Honorable Leland J. Haworth, Director, National Science Foundation.
The Honorable Eugene Rostow, Under Secretary of State for Political Affairs.
The Honorable Stanley Cain, Assistant Secretary of the Interior.
The Honorable J. Herbert Holloman, Assistant Secretary of Commerce.
The Honorable Glenn Seaborg, Chairman, Atomic Energy Commission.
Admiral Willard J. Smith, Commandant, U.S. Coast Guard.
The Honorable Edward Wenk, Jr., Executive Secretary.
Seven other observers and guests of policy rank.

NOVEMBER 16, 1966

Members Attending

The Vice President.
The Honorable Paul Nitze, Secretary of the Navy.
The Honorable John Gardner, Secretary of Health, Education, and Welware.
The Honorable Leland J. Haworth, Director, National Science Foundation.
The Honorable Lewellyn Thompson, Ambassador at Large, Department of State.
The Honorable Stewart Udall, Secretary of the Interior.
The Honorable J. Herbert Holloman, Assistant Secretary of Commerce.
The Honorable Glenn Seaborg, Chairman, Atomic Energy Commission.
Admiral Willard J. Smith, Commandant, U.S. Coast Guard.
The Honorable Edward Wenk, Jr., Executive Secretary.
Eight other observers and guests of policy rank.

JANUARY 18, 1967

Members Attending

The Vice President.
The Honorable Stewart Udall, Secretary of the Interior.
The Honorable Philip Lee, Assistant Secretary of Health, Education, and Welfare.
The Honorable Robert A. Frosch, Assistant Secretary of the Navy for Research and Development.
The Honorable J. Herbert Holloman, Assistant Secretary of Commerce.
The Honorable Glenn Seaborg, Chairman of the Atomic Energy Commission.
The Honorable Leland J. Haworth, Director, National Science Foundation.
The Honorable Nichols deB. Katzenbach, Undersecretary of State.
Admiral Willard J. Smith, Commandant, U.S. Coast Guard.
The Honorable Edward Wenk, Jr., Executive Secretary.
Eight other observers and guests of policy rank.

April 17, 1967

Members Attending

The Vice President.
The Honorable Foy D. Kohler, Deputy Under Secretary of State.
The Honorable Paul Nitze, Secretary of the Navy.
The Honorable Stanley Cain, Assistant Secretary of the Interior.
The Honorable J. Herbert Holloman, Acting Under Secretary of Commerce.
The Honorable Glenn T. Seaborg, Chairman, Atomic Energy Commission.
The Honorable Leland J. Haworth, Director, National Science Foundation.
Dr. M. D. Leavitt, Deputy Assistant Secretary of Health, Education and Welfare.
The Honorable Alan S. Boyd, Secretary of Transportation.
The Honorable Edward Wenk, Jr., Executive Secretary.
Seven other observers and guests of policy rank.

July 13, 1967

Members Attending

The Vice President.
The Honorable Foy D. Kohler, Deputy Under Secretary of State.
The Honorable Robert H. B. Baldwin, Acting Secretary of Navy.
The Honorable Stanley Cain, Assistant Secretary of Interior.
The Honorable J. Herbert Hollomon, Acting Under Secretary of Commerce.
The Honorable Glenn T. Seaborg, Chairman, Atomic Energy Commission.
The Honorable Leland J. Haworth, Director, National Science Foundation.
The Honorable Philip Lee, Assistant Secretary of Health, Education and Welfare.
The Honorable Alan S. Boyd, Secretary of Transportation.
The Honorable Edward Wenk, Jr., Executive Secretary.
Seven other observers and guests of policy rank.

Mr. Lennon. I have a series of other questions, but I recognize the distinguished gentleman from Ohio, Mr. Mosher.

Mr. Mosher. Mr. Chairman, I suggest that one of the first and one of the wisest decisions that the Council made was to borrow Ed Wenk from the Library of Congress.

I immediately gained in confidence in the work of the Council when they made that decision.

Mr. Lennon. Would the gentleman yield at that point?

Mr. Mosher. Yes.

Mr. Lennon. That is when my enthusiasm began to mount.

Dr. Wenk. Thank you, gentlemen, for your kind words.

Mr. Mosher. One indication of his ability, of course, is in this very impressive, very comprehensive and provocative report which we have heard this morning. I will take time now for only a couple of questions, if I may, Mr. Chairman.

We are all aware, of course, that there are 11 or 12 or more agencies involved in ocenaographic work throughout the Federal Government and we are all aware of the potential danger of unnecessary overlapping, wasteful overlapping in their activities. At the same time, what has concerned me more is the possibility of complete gaps, of vacuums, and I am wondering whether the Council in its first year has been able to put its finger on and identify areas of crucial need in the marine sciences and engineering, which are not being touched.

Have you discovered any such areas?

Dr. Wenk. Mr. Mosher, I personally share your view as to the gaps being more serious at this point in history than the possibility of unwitting duplication. Almost all of the new areas that the Council is examining cross agencies lines and do involve a number of agencies.

I will illustrate this in a moment. First, I should note that the gap is not so much one of the problem having been overlooked as it is a question of who has the responsibility. When you have a number of different agencies involved, each with many things to do that are established by law, during tight budget years, it is not unexpected that some of these problems get no attention.

One of the areas intriguing the Council at this time concerns the problems of the seashore. We have increasing utilization of the seashore for recreation, for commerce, for economic development considering our fisheries, both sport fisheries and commercial fisheries, and the possibility of oil and gas off of our shores, including the east coast —and we know now off the coast of Alaska—more than we ever expected. Paradoxically at the same time, the seashore is undergoing degradation from the ravages of nature itself and from pollution.

Here is a case where you have four or five different Federal agencies involved, all in an important way: The Corps of Engineers; the Federal Water Pollution Control Administration; also within the Department of the Interior the Bureau of Commercial Fisheries, the Bureau of Sport Fisheries and Wildlife; the Geological Survey; the Bureau of Mines; the Coast Guard. Our role is to try to illuminate the problem and then bring together around one table representatives from these agencies to exchange ideas, and to plan together on what we ought to be doing that we haven't done in the past.

Another program will also illustrate this very point. The food-from-the-sea program is a responsibility of the Agency for International Development. Nevertheless, its success depends on significant contributions from the Bureau of Commercial Fisheries related to a better understanding of where the fish are. Since this depends upon understanding distribution of temperature and salinity in the ocean, data also utilized are collected by the Navy, the Environmental Science Services Administration and other agencies. Again, to satisfy that objective, we found a problem that in the past everyone recognized, but there had not been a formulation of a plan or designation of responsibility.

I want to emphasize that these agencies are eager to work together on these problems, and this has been one of the most encouraging results of our legislation. Although they have worked together over the years, the legislation now provides a new framework by which their efforts are better mobilized. Very often, lower levels of Government had not been appreciated, and now we have Cabinet level officers examining in detail what has been going on for years within these individual departments.

Mr. MOSHER. You have not found any gap that is going to require a recommendation for a new agency or anything like that?

Dr. WENK. Not in precise terms. What we are really trying to do at this point is to understand better what the future uses of the sea may be. Then the Council in its appropriate role will be better prepared when the Commission renders its report to concern itself with how the Federal Government might possibly be realined in order to serve those purposes. At the moment, we are concentrating first on what we should do more of in the ocean rather than the question of how to reorganize.

Mr. MOSHER. I think you referred to the lack of adequate storage and retrieval facilities for oceanographic data and your studying that lag. That would be an extremely crucial lag if it exists.

Dr. WENK. Data are really the commodity that makes up oceanography. Without the observations, you would have no oceanography; you would have no marine science.

As we look back historically, we find that most scientists collected their own data and utilized their own. But today the collectors of data are not necessarily the users or vice versa; in other words, we now have a much larger community of users of oceanographic information who may never even see the oceans, including people concerned with policy questions that depend on marine science data. As a consequence, it was the Council's view that steps should be taken to understand better the whole range of user needs, not only in the Federal Government but in industry—the offshore oil industry, for example, has important requirements with regard to wind and weather—and the requirements of the academic community in order to determine what was needed, and then finally—and we have to face this squarely—what it is going to cost. We can't improve the system without some additional investment.

Mr. MOSHER. Mr. Chairman, one more question: Dr. Wenk, on page 5 it says that, "When missions cross agency lines, however, the Council may designate a lead agency to assume responsibility for interagency planning and coordination."

This assumes an authority in the Council to really give direction to the agencies and tell one agency to lay off and another agency to emphasize and that sort of thing. Have you had occasion to issue any such instructions to the agencies, to assume that responsibility?

Dr. WENK. Yes, we have, Mr. Mosher.

Let me mention, first, that each participating agency in a multiagency program is doing whatever it is doing in accordance with existing statutes. In many cases, I think it is fair to say that because the legislation for these agencies cannot keep up with the changing world, some of the problems, particularly with regard to whether they call on one agency or another, become unclear. The role of the Council in this instance is to advise and assist the President, in accordance with section 4(a)(3), which in fact provides for the Council to assist the President in this regard.

Mr. MOSHER. You make recommendations to the President and he is the one that directs the agencies?

Dr. WENK. Right.

Mr. LENNON. Gentlemen, off the record.

(Discussion off the record.)

Mr. LENNON. The committee will stand in recess until the call of the Chair.

(Whereupon, at 11:10 a.m., the subcommittee recessed, to reconvene at the call of the Chair.)

NATIONAL MARINE SCIENCES PROGRAM

THURSDAY, AUGUST 24, 1967

House of Representatives,
Subcommittee on Oceanography of the
Committee on Merchant Marine and Fisheries,
Washington, D.C.

The subcommittee met at 10:10 a.m., pursuant to call, in room 1334, Longworth House Office Building, Hon. Alton Lennon (chairman of the subcommittee) presiding.

Mr. Lennon. The committee will resume its hearings that were interrupted last Thursday when the committee was required to recess due to an 11 a.m. call of the House.

You will recall that last week Dr. Wenk completed his prepared statement, but there was little, if any, time for questioning except briefly by Mr. Mosher and myself. We anticipate that the committee room hopefully will be filled in a few minutes.

I regret to announce that it is necessary for me to relinquish the chair this morning, because I have to be present at another committee meeting, but the hearing cannot be chaired by anyone more concerned or interested or a more articulate person than the gentleman from Florida, Mr. Paul Rogers.

Dr. Wenk, if you will have a seat, sir, and if in the interim you have any additional comments with which you would like to supplement your prepared statement, we would be delighted to have those before the questioning starts.

STATEMENT OF DR. EDWARD WENK, JR., EXECUTIVE SECRETARY, NATIONAL COUNCIL ON MARINE RESOURCES AND ENGINEERING DEVELOPMENT—Resumed

Dr. Wenk. First, Mr. Chairman, may I again express my thanks, those of the Vice President and the members of the Council, for this opportunity to appear before your committee and to acknowledge how important your interest is to progress of this whole field. I was able to communicate your very kind remarks to the Vice President and the members of the Council with regard to progress in these initial stages of the Council. I know that I speak for all of them in expressing our gratitude. We recognize—and this is a point that the Vice President has emphasized time and time again—that this legislation was initiated by the Congress, by this committee, so that it is all the more gratifying, then, if these early steps are meeting expectations of the parents of this whole enterprise.

Mr. Lennon. Doctor, we are very grateful for those remarks. The Vice President was kind and gracious enough to send me a personal note expressing his appreciation for our reception of you here last Thursday and for the affair which some of us attended last Thursday evening with the Council, the President's Commission, members of this committee, and Members of the Senate, at which we were privileged to hear the Vice President with his usual enthusiastic interest and concern.

If we had more folks with quite the go-go that the Vice President has, we would really go forward in this field. Mr. Rogers, will you take the chair now and recognize the members who are here, and if they don't have any questions, come back to the counsel.

Mr. ROGERS (presiding). Mr. Karth?

Mr. KARTH. Mr. Chairman, I want to join Mr. Lennon and our other colleagues who have very ably and enthusiastically endorsed what Dr. Wenk has said. I might say I also join them in congratulating him for having done such an extremely able job in such a short period of time.

I might say, Dr. Wenk, that I am one of those who feel very strongly that in most cases study commissions of this kind probably are somewhat of a waste of time. I want you to know that I don't feel that way in this instance.

I think that the magnitude of your job is of such nature and scope that really, when we wrote the law, we probably didn't recognize and didn't appreciate in our own minds just what kind of a job this was going to demand on the part of the Commission and the Council.

I think, Mr. Chairman, that when some 27 agencies of Government are involved in the matter that we are all interested in, oceanography, in one way or another, we can then better understand the job that Dr. Wenk and his staff and the Council and the Commission have to do.

I am not just interested, Dr. Wenk, in the field of oceanography because it is exciting and new and different and something that we all look forward to using to solve some of the world's problems in the future, but I am interested because I feel that only with comprehensive study and good solid recommendations based on fact and inquiry and investigation can we really make oceanography do what we hope oceanography will do and what we think it has to do in the future.

I am not only interested in your studies and those recommendations, but I am interested in what Congress will do with those studies and recommendations once you make them. The real point I am making and the question I am leading up to, I guess, is whether or not the time schedule that has been set out in the law provides you and your staff and the Commission and the Council with the necessary time to do the job that I think needs to be done.

If this job isn't a well and completely done job, it seems to me that we might well fail in the whole field of oceanography. I wonder, Mr. Chairman, if the doctor could address himself to that question.

Dr. WENK. I appreciate your comments, Mr. Karth, with regard to the complexity of the task that we face. Your comment about the number of Federal agencies involved is quite accurate. Other dimensions of that complexity are revealed by the number of different issues that are involved related to questions of national security, economic growth, maritime shipping, the question of the uses of the seashore, and so on. For those of us now studying this marine science area in depth, we are discovering each day more and more issues that deserve careful consideration.

With regard to the dates, the legislation sets forth a mandate which has no termination date. However, the two instruments to implement the mandate, the Council and the Commission, are both temporary, as you suggest.

My recollection is that the Commission is obliged by the legislation to render its report no later than 18 months after its appointment, which means July 1968, about 11 months hence. Thirty days later the Commission expires.

Our Council, according to terms of the legislation, terminates within 120 days after the Commission, renders its report; that is in November of 1968. I believe the intent of the Congress in making the Council temporary was to leave all the options open for the Commission to recommend whatever permanent structure seemed best to serve the various maritime interests mentioned previously without feeling that the presence of the Council, if it had been made permanent at that time, would inhibit them. Those of us associated with the Council have the feeling that this was a wise move from several points of view, but among these is the question as to whether or not the Council is the right mechanism.

In any event, the Council is only temporary. Both Council and Commission then will disappear next year.

Mr. KARTH. Mr. Chairman, if I may just follow that line of questioning briefly, this July date means, then, that just about the time we are getting into the heat of the presidential campaign, if I may be very candid about it, is the time that you will be making the report to the Congress of the United States.

I am interested in oceanography. I am somewhat doubtful that the report will get the attention that it really ought to get and otherwise would get, if it were not being submitted to the Congress at that time period. Then, because the Commission and the Council just automatically, by virtue of the law, goes out of existence shortly thereafter on or about election day, I am sure is not wise timing.

I don't expect you to be able to answer these political questions, but from the standpoint of making the kind of comprehensive study and a very intelligent report on the basis of recommendations, on the basis of your study, I wonder if that, notwithstanding the other problems I see, is sufficient time with some 27 agencies and the national security and everything else being involved?

Mr. MOSHER. Will the gentleman yield?

Mr. KARTH. Yes, I yield.

Mr. MOSHER. I am delighted to have you raise this subject. It happens that Mr. Lennon and I both have talked to Dr. Wenk about this very fact that the timing seems most unfortunate, particularly in terms of the political calendar and also the need for a longer study.

I, for one, would very much favor taking the initiative here in this committee to extend the life of both the Commission and the Council. I think you have raised a very important question.

Mr. KARTH. I thank the gentleman.

I might say that I have not talked to Dr. Wenk about this. Dr. Wenk, let me ask you this question: If this committee decides to extend both the Council and the Commission for 3 or 4 or 5 months, at least sufficient time to get over the political campaign, when I honestly feel that the Congress will not give the attention to the report that it ought to give and as a result I feel that a good deal of the work that you people are doing might be for nought, is it your opinion that we should extend, if it is agreed by the members, both the length of time for the Council and the Commission, or one or the other?

Dr. WENK. The two are connected in the legislation at the present time in that the expiration date of the Commission is set by law and the expiration of the Council is coupled to the expiration date of the Commission. Several dates come to mind in connection with your question, Mr. Karth.

I had occasion to study the history of this legislation and found that the original commission bill introduced by Mr. Rogers called for the report by the Commission in 2 years. The interval provided the Commission has thus been thought of variously as 24 months and 18 months. It was 18 months that was finally decided on in the legislation.

The issues are so complex a study of this kind needs to be done comprehensively to lay the groundwork for whatever future legislation the Congress wishes to enact once and for all. I don't believe that this is the kind of area that can be examined piecemeal and then examined a second and third and fourth time. I believe the intent of the Congress, when it passed this legislation and provided the Commission with authority to recommend some restructuring of the Federal Government, looked on it as a major step.

I can't speak for the Commission in terms of how they feel about an extension. If I may suggest to the committee, this is a question you might wish to raise with the Commission itself in terms of their feelings about such an extension.

With regard to the Council, I must say I share your concern about its expiration just about the day of the presidential election, because there is a strong possibility of a hiatus when the Council terminates until such time as some new legislation is passed.

Assuming, for example, that the Commission renders its report either as now scheduled in July or if there were some extension for the reasons that you raise, perhaps that fall, the next session of Congress would be the first opportunity the Congress would have to act on such legislation.

Mr. KARTH. Dr. Wenk, if you would permit me, it seems that if the Council terminates in the first part of November, Congress certainly would be in recess or adjournment during the months of November and December. January is a very slow legislative month around here, especially when a new Congress is being organized, and I doubt seriously that any attention would be given to it during January; so we are talking about 90 of the 120 days really when this report would get no attention from the Congress.

This is an implement to the Congress. This is our baby, so to speak. I just think, Mr. Chairman, that we ought to explore this. I have some doubts whether or not we can make this as effective and constructive as we felt it ought to be made when we first passed the law.

I recognize, too, Dr. Wenk, that when this legislation was passed by the Congress, when it was first initiated, nobody, of course, knew that it would take 6 months to set up the Commission and on the basis of the original dates, I suppose the Congress had a right to feel at that time that it was appropriate, that the time limitations were proper.

On the basis of the time that passed by during the time that the legislation was passed and implemented and effected, why, I think that maybe we ought to take another look at it.

Dr. Wenk. I agree that 120 days is a short time for implementation. Also you are correct about the dates. The legislation was signed into law in June; the Council was activated in August; and the President appointed the Commission on January 9, 1966. There was a difference in timing greater than perhaps the Congress had anticipated in terms of the possible simultaneity of the two bodies.

Mr. Karth. Thank you, Mr. Chairman.

Mr. Rogers. I might say that in some discussions that I have had with members of the subcommittee, too, I think that this feeling is beginning to take root. An extension of the Commission, and even perhaps an extension of the Council, beyond the 120 days which was originally set in the legislation might be wise, because once the Commission goes out of being, the Council then exists only for 120 days. It seems to me that it might be wise also for us to consider simply amending the present law to extend the Commission, say, 6 months and perhaps give an extension to the Council into being until the Congress would have an opportunity to act on the recommendations of the Commission. Hence, as Dr. Wenk has pointed out, we would not have a hiatus when we have a dissolution of the Commission and also a dissolution of the Council before the Congress acts on the legislation.

I think the gentleman has made a good point there. It would be a very simple bill for this subcommittee to consider and I would think it would have a good reception.

Are there any other questions, Mr. Karth?

Mr. Karth. No, thank you, Mr. Chairman.

Mr. Rogers. Mr. Mosher?

Mr. Mosher. I asked my questions at length last time, Mr. Chairman.

Mr. Rogers. Mr. Pelly?

Mr. Pelly. Thank you, Mr. Chairman.

I hate to get the committee's mind off such exciting things as presidential elections. I think perhaps Dr. Wenk will recall that right after we were interrupted to go to the floor of the House when he was here before, I mentioned my feeling that we should pay more attention to the international aspects of oceanography before entering into some of the more practical details, such as additional laws.

You referred in your testimony to the framework of law that will facilitate work on the Continental Shelf. I recall an international agreement concerning the Continental Shelf itself, or anything that touched it, excluding superadjacent waters.

The matter of conservation of fisheries resources above the shelf is certainly equally vital. We can never attain that objective until we have an international understanding or convention on the law of the sea.

I know in your position you are able to press for some sort of United Nations agreement in this area. I just take this opportunity to urge you to do it. For example, yesterday during House consideration of foreign aid, the matter of fish protein came up with regard to feeding the world's population. Certainly I think there is an appreciation of what the possibilities of resources of the sea can mean to mankind. Yet, we had an example last year where a fleet of foreign vessels came right in close to our coast and depleted stocks of hake and other materials for food. We had no agreement on that.

Finally we got a bilateral agreement with Russia and then with Japan. Until we can map out something in the way of a pattern from which we can proceed to develop the resources, I think we may have some serious setbacks. We certainly are having them in Latin America now in disputes with those countries over extraordinary assertion of jurisdiction over the high seas.

The international aspect is important. Wouldn't you agree with that?

Dr. WENK. I would absolutely. It seems to me that the legislation was rather farseeing in two regards. First, the President, with advice and guidance from our council, was obliged by the legislation to undertake legal studies having to do with the conservation, development, management, use of marine resources, both living resources and mineral resources.

Second, as I recall, the legislation had a specific section which called attention to the importance of international cooperation to the extent that it is in our interest, and section 6 provides authority for the council to assist the President in this regard.

We are taking those provisions quite seriously. We have already initiated contract studies on these legal problems. Five contracts now underway. They are modest in size, but we are endeavoring to examine the present state of international law, to consider what alternative legal regimes could be developed and the consequences of these changes.

Your point seems especially important with regard to the living resources, because we look forward to increases in fish catch as a matter of great need. Most of the marine biologists tell us that the productivity of the ocean is at least five times the present world catch of fish. This doesn't mean every species could be increased by a factor of five. It means, therefore, understanding the total productivity of the sea better, the interrelationship between the different species of fish, and the ecology. All nations of the world could thus be guided individually and collectively to conserve these resources. Conservation doesn't mean not catching fish. It means understanding what the productivity is and then catching fish under some kind of international agreement as to what could be done without reducing the long-term economic productivity of the sea.

Mr. PELLY. There was a very interesting CBS television program on oceanography a Sunday or so ago, put on by Walter Cronkite. However, you came away with the idea that all you have to do is go down and pick up diamonds off the bottom of the sea.

I don't think we should even think of taking minerals or diamonds until we have some sound legal basis establishing development rights. It worries me a little. I was encouraged, however, that we were able to work out an understanding with the Soviet Union. Russia, like ourselves, has come to realize that we have to harvest our resources on the basis of available quantity, which means practicing conservation.

I think the world is in a frame of mind, through the United Nations, to proceed further along similar lines. I think Ambassador Dean at the Geneva Convention did a remarkable job in convincing other nations that we should arrive at some international understanding but he wasn't able to go far enough.

Dr. Wenk. I certainly appreciate your stressing that point. It is very important and should have priority over almost anything else.

Mr. Rogers of Florida. Mr. Jones?

Mr. Jones. I have no questions.

Mr. Rogers of Florida. Mr. Keith?

Mr. Keith. Thank you, Mr. Chairman.

I would like to pursue the thoughts that have been expressed by Mr. Pelly and focus for a moment on the resources of the Continental Shelf that are covered by a law which we passed in 1964, claiming exclusive U.S. jurisdiction in this area. My question is prompted by constant reference to these resources in your testimony.

For example, on page 6 you talk about a pilot plan for offshore minerals exploration, and then you talk on page 7 about fostering collaboration between Federal, State, and local governments, and between the United States and other countries.

What I have in mind are the problems that face us if we do not stake out certain areas as sanctuaries for fish, shellfish, and other marine life. We are permitting and encouraging private geophysical research for the mineral resources of the Continental Shelf, and once somebody finds what they are looking for, then they are going to go ahead and develop these mineral resources, which could have an adverse effect upon the conservation of marine life.

So, I think that some agencies within the Federal Government should explore on an expedited basis the possibility of setting aside certain sanctuary areas for exclusive development of wildlife, fishing, and recreation.

My people of Cape Cod are very much concerned that companies might discover oil just off their shoreline, and there has been a lot of commercially valuable fish killed up there by exploratory teams that have been using explosives in their efforts to find oil and other mineral substances. I believe that there are many safer places for them to go outside of recognized fishing grounds.

Those areas which are primarily recognized as fishing grounds or habitats or breeding grounds, it seems to me, should be off limits until the oil companies have explored other areas. I would appreciate your comment as to how you view this problem and what you are doing about it.

Dr. Wenk. First, Mr. Keith, the problem that you have identified here is indeed serious and of concern to us. The problem is essentially one of conflicting uses of our resources. One example of the conflict was the one you mentioned here of the possible pollution by mineral development of a resource that at the present time is a rich source of food.

There are other conflicting uses of the seashore, as between preservation of marshland as nursery grounds for fish versus the fill of those lands for industrial or real estate development. There are conflicting uses between recreation and navigation. There are conflicting uses even between sport fishing and commercial fishing.

At the present time, we are trying to understand better whether, in fact, these uses are mutually exclusive, or whether these conflicting uses can be reconciled by a mutual protection of each of the interests.

The problem that you cite with regard to oil exploration is one where neither the presence of the oil nor its extraction would be an automatic hazard. However, there is a question of whether you kill fish by, for example, the use of dynamite rather than sparkers for geological exploration. This is a hazard that can be guarded against.

Another kind of hazard is the possible leakage of oil from the development site, either from the wellhead or from the ships or barges that carry oil to shore. Here, again, this hazard can be evaluated, and the possibility exists of good engineering that would permit the use of one resource without a hazard to an adjacent resource.

But these things don't happen naturally. Here is a case where the Federal Government and the State governments have some responsibilities to all of the public and private interests to make sure that no one inadvertently destroys or impairs the use of one of these resources for one of the interest groups.

Setting aside such an area is one possibility. We have done this when we set aside wilderness areas on the land to assure continued protection of some part of the country.

Mr. KEITH. You see, what we are concerned about is the extent of the exploration, the thrust being given to it by governmental encouragement and by the oil companies' interests in getting in on the ground floor. What we are talking about in a way is zoning of portions of the sea, but if oil interests get established there, it will be almost impossible to get any zoning through.

Since there are many, many other areas that are potentially valuable for oil, why not encourage the exploration of those areas and discourage it in those where the value is so obvious for fish breeding and feeding?

Mr. EDWARDS. Will the gentleman yield?

Mr. KEITH. Yes.

Mr. EDWARDS. What has been the experience down around Louisiana where you have offshore oil rigs operating? Do you have problems similar to what Mr. Keith is talking about as possibly happening in his area?

Dr. WENK. I am afraid I can't answer the question with complete facts at my fingertips. Development off of Louisiana is the most intensive of any of our coastal States. The oil companies themselves have been aware, both from the point of view of damages against them and the matter of public interest, that they have had to examine this question. I know that they have tried quite seriously to prevent pollution as a result of any accidents on these offshore rigs.

The question, however, is going to be aggravated in the gulf because the number of rigs will increase very sharply over the next 10 years. This past June, the Department of the Interior offered for lease a whole new section of the gulf in deeper water than had been available before. It is rather striking that the oil and gas companies bid both more in total amount and higher unit rates for this offshore property than has ever been the case before. This indicates a trend from the point of view of the attractiveness of moving offshore for oil and gas. Assuming that this offshore development continues at this rate, the number of problems is going to also increase, problems from the point of view of naviagtion with a much larger number of fixed rigs in the gulf and a statistically greater problem of pollution from more sources offshore.

The end result is the problem that we are going to have to examine. I would like to give you gentlemen assurance that this is very much on our current agenda. One of the five new committees appointed under our Council is concerned with the multiple uses of the seashore. Following a "lead agency" concept that we enunciated earlier, we have asked the Department of the Interior to chair this committee and have given them some immediate assignments to come in this fall with recommendations possibly for legislative activities in this area.

Mr. KEITH. I am grateful to you for pursuing that possibility and getting further details on the problem. I realize that we don't have too much time and there are others who want to question.

I would like to get to fish protein concentrate. I will just ask one final question on this subject.

Have you given a directive or provided a contract for the pursuit of the knowledge that we were just discussing?

Dr. WENK. Yes, Mr. Keith, one of our contracts in this particular area is with Professor Garretson at New York University. There are five such contracts, three contracts dealing with international legal problems, two dealing with legal problems as between the Federal Government and the State governments. This set of problems that you have identified is encompassed within that second group.

Mr. KEITH. I think the race is on. There has been so much talk about the richness of the sea and, for the commercial interests, imports being as they are in the fishing industry, it is not very profitable, conservation is getting to be a problem and, therefore, they don't have the public support which the oil industry does, and I would hope that, before they stake a claim so that it is going to be very difficult to displace them, that we would set aside some areas.

We can always undo what the Congress does. If we pass a law setting up a zone, we can undo it, but if somebody gets in there with their oil rigs, it is a very difficult thing to get them out.

Dr. WENK. I would like to underscore again the fact that we share your concern about the problem. The *Torrey Canyon* pollution incident dramatized some of the consequences of oil pollution to the beaches of England and France and possibly also to the hazards to some of their shellfish.

That tanker was jumboized to enlarge its size.

Mr. KEITH. Yesterday this committee took that up in executive session and agreed to publish 2,000 copies of a report that I rendered on that subject.

Dr. WENK. Thank you.

Mr. ROGERS of Florida. Mr. Hanna?

Mr. HANNA. Thank you, Mr. Chairman.

I certainly want to join the very enthusiastic reception that has been accorded your remarks, Dr. Wenk, and I want to make two points, one general and one specific. Both of them have been alluded to, I think, by the previous questioners.

The first general observation I would like to make about your comments is that I think that in "oceanography" you have a characteristic situation in which we invent a catch phrase to cover chaos. The mentality of the present is that, if you invent a collective noun, you have somehow made a contribution to knowledge. We want to be sure that in our use of "oceanography" which changes the approach on an important area we have noun and subject matter.

It seems to me that, by alluding to the fact that we have so many people in this field, we are aware that there has been a tunnel-vision approach into the very important area of the sea. Each fellow is looking down his tube. If he is after oil, that is the tube he is looking down, and he says, "Don't bother me with anything else. I am after oil. It is important. We ought to get it."

It seems to me that what the Council is trying to do under the law that Congress set up and the significance attached to our use of "oceanography" is that we want an ecological interrelationship type approach. Is that a correct analysis?

Dr. WENK. I think that is exactly right. We are trying to look at the relationship of these problems to the marine environment in which they exist. The ecological approach, I think, is correct.

The other aspect of this problem which touches on your point concerns the cross-connections necessary between the people looking down these different tubes. Someone once referred to the problems of the structure of government in terms of a fabric with only a "warp." What we are trying to do is provide a "woof" at least within the Federal Government, and also communication among the Federal Government and States and the private sector.

Mr. HANNA. You want to catch the stuff that is falling between the cracks that people said wasn't anybody's responsibility. The specific part of your remarks that I wanted to follow up is the one introduced by Mr. Pelly.

You will recall that in 1963 I first remarked about the problem of the law of the sea, and in 1964 I introduced a bill related to that and in the testimony on this bill I suggested that that be added with the remark that in some of the areas of the law of the sea we were just about to reenact our frontier experience in the United States, where the law of the six-gun prevailed and it seems like the violence gained therefrom is nine points of the law.

We had a pretty bloody chapter in the history of America while we went through that experience and we wouldn't want it reenacted in the law of the sea. It seems to me, gentleman, that to understand it you have to realize that there are three areas of the law.

See if this is in accord with your understanding. I am not much on Latin, but there is what we call in Latin "res nullius" that in my parlance would be the law where nobody owns anything. There is the "res communes," which is the place where everybody owns everything and then there is that area in which there is sovereign claim, which means that that is mine. I own it.

Now, it seems that where we are now is that we have to keep our minds separated in all three departments as to what part of the law we are addressing ourselves to and each is changing. There is no fixed framework for this because what we have learned is that as the techniques and technology changes, the boundary lines between these three frameworks of the law change, don't they?

In other words, nobody was really heavily involved in what is in the subsoils of the sea until very recently and that is now extending quite a ways out. The Senator from Idaho, Mr. Church, suggested that the U.N. ought to have the bottoms of the deep sea.

It seems to me that that is a quick answer, but I just wonder how practical it is. With these things moving out, are we better off going in this direction which, it seems to me, is reenacting when we discovered the New World.

You gentlemen will recall, or your history will tell you that there was a papal bull that divided the whole New World even before people had a good map of it. That papal bull really did too much for what was involved as to who controlled what in the New World, and I don't know that the U.N. would be in any better position than the Pope was at that time.

In fact, I don't think they are probably as good. They don't have any troops and they don't have some of that other persuasion that the Pope had. Although the Senator's view is pretty exciting, it seems to go ahead of the game.

The law is a living framework and it goes with experience and development. Isn't it true that in the North Sea we are seeing the development of international law following a more pragmatic and practical approach in law? Wouldn't you say so?

Dr. **Wenk.** Your observation about the North Sea is absolutely correct, Mr. Hanna. This is a rather interesting time in history in that we do have an opportunity to develop a better understanding of the uses of the resources of the sea and to clarify questions of sovereignty before we get into a shooting match over these resources.

The convention that one of your gentlemen referred to earlier, I guess Mr. Keith, that was ratified in 1964, clarified this picture with regard to seabed resources on the Continental Shelf. It defined that shelf as the adjacent land to a depth of 200 meters, roughly 600 feet.

Mr. **Hanna.** If you will yield there, wasn't there some Mickey Mouse language in these that said in addition to the 200 meters or to that depth at which there could be demonstrated a practical extraction?

Mr. **Rogers.** Ability to exploit.

Dr. **Wenk.** That is correct. It said out to a depth to which it was practical to exploit, but only out to a median line which would be implicitly a line drawn in the ocean midway between the coasts of two nations facing each other.

Median lines must also be established when nations are along the same coast. The North Sea is a good example of where they had to be negotiated. In most instances, such a boundary at sea is ambiguous until nations agree themselves as to what it shall be, and these may be developed on a bilateral basis. With one or two exceptions, agreements in the North Sea—have proved satisfactory.

With regard to extension of sovereignty to deeper water, the definition of the median line not only becomes fuzzier, as you suggest, but it raised some very serious questions. We can take the case of the Atlantic Ocean by way of example. Most of us would immediately think about the Atlantic coast of this country giving us access at least to half of that Atlantic Ocean. But when you consider that there are other nations facing on this same body of water: Cuba, Canada; from the other side, the Azores belonging to Portugal; a small island belonging to France where the question of this extension from a small island is just as potent as from a major continental boundary, we immediately see that the complex geography including the question of our own national interest is not as clear as it might be.

For this very reason we are studying this question intensively at the present time.

The proposition that Senator Church advances is one of many alternatives. I can say positively that the administration has taken no position at all on this proposal. We are looking at many possibilities. This includes trying to implement the median line concept enunciated in that convention. These have to take into account such complex questions as the fact that the exploitation of mineral resources by U.S. industry takes place off the shores of other countries as well as off our own.

Therefore, from the point of view of the problems of domestic economic development in which our industrial interests are also concerned, it is not as simple a question as simply saying which seabed belongs to which country. It is looking at the picture in a somewhat broader context.

This subject needs careful examination. It is going to need debate. It is going to need the concern and the attention of all of the interested parties. I know that, Mr. Rogers, you have had an interest in this personally and other members who are on this committee have this interest. I believe that we now have to look at these issues rationally.

Mr. Hanna. I thank the gentleman for his remarks. I am prepared to insert in the record a collection of what I think are some of the most pertinent remarks up to the present time, and I would also like to extend for the committee what I am sure is their feeling, which is congratulations to the American Bar Association on the recent meeting that they held on the law of the sea.

I think all of this is going to be very productive.

Thank you, Mr. Chairman.

(Information follows:)

[From the Congressional Record, August 24, 1967]

The Law and the Land Under the Sea

Extension of Remarks of Hon. Richard T. Hanna, of California, in the House of Representatives

Mr. Hanna. Mr. Speaker, the enthusiastic romance with the promise and potentials of the "wet frontier" of the world's oceans has continued through the last few years, unabated. On a more practical plane, Government agencies have cautiously extended their activities, sensing a possible explosion of funding for mission-oriented projects. Most impressively, private industry has committed substantial resources toward engineering and scientific projects for meaningful intrusions into the underseas environments. All this has appropriately engendered rising concern over the status of the law of the sea and how, given the underdeveloped condition of this facet of jurisprudence, orderly and effective development and exploitation of the envisioned potentials can be realized.

Viewpoints of concern include our own early observations before the Oceanography Subcommittee over a year ago, when we likened the prevailing lawless conditions in the "wet frontier" to the situation in the early "west frontier." The rule of the six-gun prevailed. The violence of possession gained, being nine points of the law, we were provided with a bloody chapter in our development. To reconstruct that history in the sea in an international scramble for possession and protection would not be appealing. However, to see in this dilemma the necessity for cooperation and mutual assent to some developing rules does not in our judgment dictate an immediate turning to the United Nations, as some have suggested, as the sole forum for an answer. Our attention, as has that of other thoughtful and concerned persons has been drawn to the proposal, most recently expounded by the able Senator from Idaho, Senator Church. We choose to look upon the Senator's suggestion as an invitation for a broad dialog on the problem.

In the hopes of encouraging a continuance of investigation and suggestion, we have set down some thoughts which, in our judgment, question the wisdom of a hasty turn to the United Nations at this juncture in the emerging situation under seas. This is not to say that some role cannot in the early stages be assumed by the United Nations. Nor is it to deny that ultimately, that role may wisely be expanded.

Pragmatically, it strikes us that the more productive approach would be in limited stages, closely associated with practical problems as they occur, and the gradual working out of problems of cooperation within a framework of internationally binding law.

During the period in which modern international law evolved, the bed of the sea and its subsoil were technologically inacessible, As a result, no specific doctrine was developed as to ownership and exploitation of submerged areas. Whether the exercise of sovereignty over the territorial seas and contiguous zones included a like or lesser control of the subsoil and seabed was not a matter of practical or legal importance.

Unilateral action regarding sponges and pearls—in areas called fisheries—represented the initial attempt to control areas of seabed. In English jurisprudence, the isolated incidents of litigation and subsoil rights were brought by the Crown as a result of the extension of mine shafts beneath territorial seas.

Nonetheless, two general principles have evolved which could be applied. One is the Roman doctrine of res communis, or common to all. This has provided the basis for the generally accepted doctrine of freedom of the seas. Institutions of this doctrine would prevent any establishment of national sovereignty. The second doctrine, is that of res nullius, or belonging to none. Such a doctrine would permit the acquisition and extension of sovereignty into such areas as were not already occupied. The two doctrines, of course, are incompatible.

It has been only recently, when modern technology has made it feasible and profitable to drill oil wells into the subsoil, and when projections of future interrelated demands for energy, water, and minerals from the sea have been established, that the importance of ownership of the seabed and subsoil has become fully recognized.

In 1945, President Harry Truman issued a landmark proclamation in which he expressed the view that—

"The exercise of jurisdiction over the natural resources of the subsoil and seabed of the Continental Shelf by the contiguous Nation is reasonable and just."

And proclaimed further:

"The Government of the United States regards the natural resources of the subsoil and seabed of the Continental Shelf beneath the high seas but contiguous to the coasts of the United States as appertaining to the United States (and) subject to its jursidiction and control."

This, however, could be explained as a domestic matter in the historic sense, Soon, however, in light of the new technological capabilities, it became necessary to extend the width of territorial waters and to establish contiguous zones, formerly regarded as high seas areas.

As a result, the Convention on the Continental Shelf attempted to establish a method for national control over the seabed and subsoil of the Continental Shelf, so that sovereignty over the superjacent waters would not be extended. Unfortunately, the Convention adopted a double standard for establishing the limits within which the coastal state may exercise "sovereign rights for the purpose of exploring and exploiting" the Continental Shelf. The first article of the Convention provides that—

"The term 'continental shelf' is used as referring (a) to the seabed and subsoil of the submarine areas adjacent to the coast but outside the area of the territorial sea, to a depth of 200 meters or, beyond that limit, to where the depth of the superjacent waters admits of the exploitation of the natural resources of the said areas; (b) to the seabed and subsoil of similar submarine areas adjacent to the coasts of islands."

And the second article then declares that—

"1. The coastal State exercises over the continental shelf sovereign rights for the purpose of exploring it and exploiting its natural resources.

"2. The rights referred to in paragraph one of this article are exclusive in the sense that if the coastal State does not explore the continental shelf or exploit its natural resources, no one may undertake these activities, or make a claim to the continental shelf, without the express consent of the coastal State.

"3. The rights of the coastal State over the continental shelf do not depend on occupation, effective or national or on any express proclamation."

The implications of this doctrine present numerous problems in international law of the sea. What remains unclear is the outer boundary of this exclusive area. What if the seabed has deep trenches in it? Does the coastal jurisdiction revive farther at sea? Under part (a) of article I, cannot one state just keep going, out into the sea up to the point where another state makes a similar claim? And then, where are we left? Furthermore, what about the area beyond the coastal state's jurisdiction, what regime rules here? Does res nullius or res communis apply? It would seem that in reality, the only limit is that which is measured by the criterion of exploitability.

There is a growing concern that somewhere in the near future a few oceanographic powers will be able to occupy and thus appropriate all the deep ocean mineral areas that could be developed for some time.

Recently, President Johnson called attention to these dangers in his remarks at the commissioning of the new research ship *Oceanographer*:

"Under no circumstances, must we ever allow the prospect of rich harvest and mineral wealth to create a new form of colonial competition among the maritime nations. We must be careful to avoid a race to grab and to hold the lands under the high seas. We must ensure that the deep and the ocean bottoms are, and remain, the legacy of all human beings."

Clearly, we are now faced with some fundamental decisions about rights and uses of the lands beneath the sea. Pressures for making the decisions are mounting daily.

In a paper prepared for the American Bar Association National Institute on Maritime Resources. Mr. Francis T. Christy, Jr., outlined the criteria for the establishment of a useful regime over the sea. In part, he stated:

"In considering the alternative regimes, the basic objective is to arrive at that regime that will be viable over the long-run and that will encourage the economically efficient, peaceful, and orderly exploitation of the minerals of the sea floor. Its success will be measured against three criteria. First, it must permit economically efficient operations. Second it must be acceptable to a sufficient number of nations both in the long and the short run. And third, it must be feasible."

In the United States, the Commission to Study the Organization of Peace, in its 17th report, dated May 1966, presented its arguments for the proposal that—

"With respect to the bed of the high seas beyond the continental shelf and to outer space, which are outside the jurisdiction of any state, we urge the General Assembly to declare the title of the international community and to establish appropriate administrative arrangements."

With the United Nations owning and licensing for exploitation the sea floor minerals, the income would naturally flow into the U.N.

And, on February 15, 1967, Senator Frank Church proposed that—

"By conferring title on the United Nations to mineral resources on the ocean floor beyond the Continental Shelf, under an international agreement regulating their development, we might not only remove a coming cause of international friction, but also endow the United Nations with a source for substantial revenue in the future."

On the surface, we suppose, this may seem to be a most logical, necessary, and simple proposition. But a more than cursory look at the implications of such a move would reveal some of the numerous problems which arise.

The U.N. would have to acquire jurisdiction over resources on and under the sea floor in order to permit it to grant and protect exclusive rights of entrepreneurship and to withhold areas from exploration and development perhaps for the use of missile ranges and such. Would allocations be made to nations or to individual developers? In addition it would have to have the power to tax or extract rent or royalty payments for the use of the resources. It would also have to be granted the ability to utilize or distribute these revenues in an acceptable manner and boundaries for its own jurisdiction would have to be established. Probably some scheme would have to be enforced whereby the interest of the adjacent coastal states would be recognized and perhaps they would split royalties with the U.N. Some equitable method for doing so would have to be found. Perhaps the closer the exploitation to the shore of the state, the greater its share of the royalties. Some form of a bidding mechanism would be necessary to insure efficient and fair allocation of the rights of exploitability.

Many other controls would have to be established. Definite time limits for performance of the required exploration and exploitation would be necessary as would some form of inspection to insure that the requirements of the lease were being upheld, that maximum care was being taken to insure that the marine environment was not being damaged, and that the resources were being used efficiently.

Administratively, the placing of jurisdiction over the sea in the hands of a group such as the United Nations poses numerous other problems. Initially, we must ask, where a qualified staff would be found. How could they determine the size of a possible lease, the duration or terms of renewal, the royalties or taxes which should be applied, the method of awarding concessions to competing groups, the amount and nature of control of production and prices, and effectively establish and enforce the controls and requirements previously enumerated as well as those yet unnamed, except on an extremely arbitrary basis? With a questionable degree of urgency, should we not be sure that we are on solid ground before committing ourselves to a position we might later regret?

It has been pointed out that a great deal of money is required for deep sea mineral exploration, but even more will be necessary for production. Only a few very large companies, and a few national governments have the necessary risk capital readily available. Of the 135 national states in the world, 109 border on the sea, but the governments likely to be involved in undersea operations of this nature number no more than a dozen if we take into consideration the factors of financial capacity, maritime experience and undersea technology. But, these are the very same nations with important military and strategic interests in the sea. In the past they have not found it necessary or expedient to ask permission from the United Nations to carry out their undersea operations. In the future, it is doubtful that they are going to find it necessary or desirable to ask the U.N. for permission to carry out their mineral explorations.

Furthermore, these are the very same nations which have veto powers in the Security Council and extraordinary bargaining powers in the General Assembly.

Then again, it is rather inconceivable that nations large or small would concede taxes and royalty rights, previously under their own jurisdiction to a nonsovereign agency for the granting of a right which it only obtained power to grant because these nations elected to create such a device. The United Nations' primary function is that of a mediator, not a sovereign. Nor would many nations be ready to accept a proposal which would permit emplacement of foreign controlled structures near their coasts. Many coastal nations would undoubtedly have to yield rights previously asserted. The United States, for example, has granted a phosphate lease some 40 miles from the coast of California in 240 to 4,000 feet of water.

Furthermore, even despite inspection controls, many states would naturally be apprehensive about positioning structures, under foreign control, near their shores, because of potential interference with navigation, fishing, recreation, submarine pipelines and cables, and military exercises. Such structures would be potential bases for covert espionage and military purposes, as well as potential producers of pollutants which would eventually reach the adjacent shores.

We readily doubt that we are at an appropriate stage in ocean development for the establishment of detailed rules and principles for allocating and regulating the use of the ocean. Our view of the future is rather dimly perceived. There are an infinite number of varied possibilities in the field of adapting the ocean to human benefit. While we can hope to prepare for dealing with a variety of possibilities, and attempt to make extremely flexible, tentative, resolutions for anticipated problems, we cannot be nearly as optimistic if we seek to definitively resolve problems now which are hard to define except in the most general of terms. Can we effectively formulate rules for the exploration and expolitation of resources before we know what and where these resources are? Thus allocation of sovereignty to an international community should be considered a bit premature at this time.

Our present knowledge of the future of drilling and production technology is similarly limited. We really have very little knowledge of what the state of such machinery, and the problems they could conceivably present in the near future are or what their course of development would be. Due to this unpredictable technological timetable and in the name of efficiency, and to avoid unnecessary restraints on efficient equipment should we not wait until we are more familiar with technology before adopting treaty principles?

As far as the need for providing a source of income for the United Nations is concerned, a number of points should be made. If the world powers, whose assent would be a prerequisite to a plan to turn the ocean floor over to the U.N., desired to support that organization wholeheartedly, they certainly could do so without resorting to the sea at this stage in time. Certainly a restructuring of the General Assembly would be a necessary requirement before the major powers would agree to permit it to dispose of large amounts of money obtained independent of their control, but in reality, at their expense. Current political realities make this a necessity.

Certainly, the U.N. presently has enough administrative problems with which to deal. It can ill afford additional burdens at this point. It has recently become all too evident that the U.N. has a long way to go in its maturation process. Doubts must be raised to the U.N. plan with respect to two of the three listed criteria : acceptability and feasibility.

The rather dramatic and immediate demonstration of how more effective international and regional programs can play in the exploitation of the ocean bed can be seen in the arrangements now being worked out for the extrication of gas from under the North Sea.

By the multilateral determination of the interested countries along general principles offshore ownership of the gas and other mineral deposits under the North Sea have been extended along a median in that body of water. The median lies between two masses of land and is supplemented by unilateral agreements on the actual division line of arc segments coming from sovereign coasts. Because of this, understandings are emerging which make a peaceful, productive and equitable solution to the North Sea problem appear eminent.

The thrust of our argument questioned whether having this matter within the jurisdiction of the United Nations would have unscrambled this situation in anywhere near the time frame than this more practical handling was able to, nor could we predict that United Nations handling would have provided any more equity than that which was worked out on a regional basis.

There are broad ramifications that can make a very definite contribution to the emerging patterns of the body of law relating to the resources of the sea where competing national interests impinge one upon the other. The North Sea experience suggests positive ramifications.

A large portion of the law will have to come into being based upon practical experiences similar to that resulting from the North Sea situation where the benefits of cooperation easily outweigh the benefits which may accrue from an antagonistic and aggressive posture.

The world's existing mineral laws, operating above the sea have evolved in an orderly manner from centuries of struggle with problems far less complex than these. Together with a maturation of the U.N., we ought to look toward a maturation of the law of the sea, before burdening it with additional, and perhaps naive codes. It would be wise to let the scientists precede the lawyers in this field. Case law seems far more practical than codes prefabricated in an unknowledgeable vacuum.

The issues are highly complex, the political dangers great, and the economic consequences potentially enormous. A great degree of caution is vitally necessary.

Mr. ROGERS. I might say to the gentleman from California that I share your concern about the Church proposal. I would hope very much that the Council and the Commission, if they are also considering this, would certainly consider all other alternatives before they even give consideration to the Church proposal. I think it would be a great error for us to throw into the United Nations the ownership of the bottom of the seas simply on some hopeful theory that they may be able to finance themselves out of this.

This seems to be the main concern of trying to get some money for the United Nations. I think this is far beyond what would be in the interest of this Nation, and I hope that we could take a very strong stand against such a position.

Mr. PELLY. I think you might rather turn over the resources of the moon to them than the resources of the sea.

Mr. ROGERS. I think the gentleman has made a good point.

Mr. HANNA. Very, very good.

Mr. EDWARDS. I think we could say that that is a bipartisan position.

Mr. ROGERS. Mr. Reinecke?

Mr. Reinecke. I would like to identify with your last remarks. I think any alternative would be preferable to giving the bottom of the sea to the United Nations. Dr. Wenk, I was very impressed with your presentation and the extent of it, in fact so much that I was very much concerned.

I would like you to give us your feeling of the relationship between the Council and Commission as far as authority is concerned.

Dr. Wenk. The Council was established to advise and assist the President on a day-to-day basis with regard to a variety of issues. The issues are the same as those to which the Commission is addressing itself.

With regard to assistance the Council provides the President, this concerns the review of what is going on in the Federal Government; the establishment of a comprehensive coordinated program; the improvement of coordination between the agencies and the designation of agency responsibility if there is ambiguity; the development of a long-range point of view with regard to these studies; and finally, an evaluation of the priorities on a Government-wide basis.

In addition, the President has asked the Council to draft for him the annual report which the law requires that he submit to the Congress.

The Commission is addressing exactly the same set of issues, but it is looking at them from a somewhat different point of view. I believe they can be far more objective, because they are outside of the Federal Government.

They are obliged by the legislation to make recommendations with regard to a long-range national plan, which by implication suggests the manner in which the different participants will articulate with each other and, finally, to make a recommendation with regard to Federal reorganization.

This final point—the recommendation with regard to a possible realinement of Federal structure—is an explicit responsibility of the Commission, one that the Council will be addressing only in its relationship of providing advice to the President.

Mr. Mosher. Will the gentleman yield?

Mr. Reinecke. All right.

Mr. Mosher. I just want to emphasize the point, as I understand it, that the Council in its advisory capacity to the President is an interim organization. It only exists until the Congress makes up its mind what its permanent status shall be and that status might be quite different.

Mr. Reinecke. I thank you for your definition. I was concerned on page 103 of your report where you outline the long-range picture of the problems to which the Council will address itself and it seems to me that to some degree you are usurping the areas of responsibility of the Commission.

You indicate the following policy areas:

> Identification of the goals of the Nation and of society and the capacity of marine sciences to accelerate progress toward these goals;
>
> The potential contribution of marine science and technology to world order and peace;
>
> The role of the Federal Government along the shoreline and in the oceans, and methods of cooperation between the Federal Government and States, regions, universities, and private industry;
>
> The administrative, legal, and technological framework for encouraging the rational exploitation of the resources of the sea;

> Further strengthening of the healthy base of scientific research which characterizes our marine science programs;
>
> Consideration of the optimum Federal organization for developing and implementing marine science policies and programs, including analysis of the recommendations of the Commission * * *.

It sounds to me that the Council has just decided to take over the Commission. Would you comment?

Dr. WENK. I would be pleased to comment on this.

I would like to come back again to the point that the purposes of the act itself are the guidelines, the mandate for the President and, in turn, for the Council. If I may refer to the legislation itself, section 4(a) states:

> In conformity with the provisions of Section 2 of the Act, it shall be the duty of the President, with the advice and assistance of the Council, to do the following things:

Section 2 of the act, which sets forth the purposes, implicitly and explicitly, goes into all of the tasks which are assigned to the President:

The accelerated development of the resources of the marine environment; the expansion of human knowledge; the encouragement of private development enterprise; the preservation of the role of the United States as a leader in marine science and resource development; the advancement of education and training; the effective utilization of scientific and engineering resources; the cooperation of the United States with other nations, and so on.

In other words, the broad goals which the Congress set for the entire enterprise became the responsibility of the President. Our role here is to assist him in this regard so that we are necessarily looking at these points mentioned in the President's report, in concert with the Commission.

The Commission, however, has a completely independent authority and opportunity. We are pointed to the same targets but approaching this independently and possibly quite differently.

Mr. REINECKE. The reason I get into this question, Mr. Wenk, is that—and I am very much impressed by the conscientiousness between all members of the Council and the Commission, particularly, as at the dinner the other night—if you are aware of the legislative history of this particular piece of legislation, you will know that a number of us were quite concerned over the fact that if we set up a council, it was a continuation of the same stalemate experienced over the years.

The Congress wanted to do something. Mr. Rogers suggested that the Commission was the real breath of hope of the legislation. I think the Council was included because the President would have vetoed the bill otherwise. This was a way to get the Commission through and establish a long-range picture as to how the Government could develop to give us the proper governmental structure, recognizing all of the interrelating problems.

Mr. PELLY. Will the gentleman yield?

Mr. REINECKE. Just a moment, please. I think what I am really concerned about here is that the Council in accepting the President's definitions or charges in that respect is moving in strongly to the area of the Commission and, even if the Commission does report itself, my personal feeling is that we may have difficulty in trying to dissolve the Council even though it is done by statute.

Mr. Pelly. I just want to correct you as far as the President wanting a Council and Commission. I was one of the conferees on the legislation. My recollection is that it was the Senate version of the bill that contained the two bodies. The House bill only had the Commission. We finally compromised along the lines now reflected in the law. There was some doubt despite the compromise language as to whether the President would accept it.

We blame plenty of things on the President. I don't want to add this.

Mr. Mosher. Will the gentleman yield?

It is my memory that the Bureau of the Budget very strongly opposed the Council at one point and, in fact, the President's pocket veto of the original legislation was because of the Council.

Also I would like to testify here personally that I have sat in with the Commission at a good many of its meetings and have been in very close touch with the members at its work, and I don't find the slightest sense among the Commission members that the Council is intruding into its domain in any way. I think the Commission feels completely free to make the recommendations, the independent recommendations, that the Congress wants from them.

Mr. Reinecke. I am glad to hear that.

I was concerned by the nature of the report here that the Council was moving into the areas of responsibility of the Commission. We certainly don't want to settle back to the comfortable position where everybody goes his own way, as we had previously.

This is the reason I bring this out.

Mr. Rogers. Will the gentleman yield?

Mr. Reinecke. Certainly.

Mr. Rogers. I think it is well to bring this out because, as the gentleman already said, it was clearly the intent of the Congress that the Commission be completely independent of the Council. In fact, we said that the Commission would make its report directly to the President and to the Congress, not to anyone else. This was the intent of the Congress and I hope this is the way it is functioning. Certainly it should.

Mr. Reinecke. I hope so, too, Mr. Chairman.

I point out that one of the problems to which the Council will address itself is consideration of the optimum Federal organization. It was my opinion that that was purely and solely the business of the Commission, not of the Council, but that the Council would help to coordinate and improve the intergovernmental relations of ongoing programs over the next couple of years, and that the Commission would address itself to the problems of this nature.

I am sure you gentlemen can be of great assistance to the Commission and apparently this has been the case, but I think we do want to make it very clear that we want to move forward. We want a program that will continue without a lot of interdepartmental and interagency rivalries.

We would like to see some improvement on the coordination of these problems and exchange of ideas.

Dr. Wenk. I appreciate the gentleman's remarks. I would like to just amplify one or two comments made regarding the relationship between the Council and the Commission, and then a brief point with regard to this matter of Federal structure.

At the very first meeting of the Commission, the Vice President made explicit reference to his understanding that this was to be an independent study. What he did was to offer the resources of the Federal Government, the agencies and the Council to assist the Commission in any way that they wished, but that he recognized they had a completely independent job to do. Furthermore, provision of four advisors on the Commission from the Congress was an indication of the view of the Congress with regard to this independence.

Incidentally, Mr. Mosher and Mr. Lennon have been present at every one of these Commission meetings from what I understand, and this concept is proceeding. We have, however, wanted to sit down with the Commission and make sure that as we move ahead in the Council, that we are not headed off in directions that might at a later date be completely opposite to what the Commission wants to do.

In other words, the President in wanting to implement the legislation promptly and effectively would not want to take steps at this time which a year from now were criticized by the Commission as being in the wrong direction. As a consequence, we have made it a point of practice to invite the Chairman of the Commission to every meeting of the Council, to make sure that they have the opportunity of seeing what the Council is doing and to speak their mind or the Commission's mind if we appear to be headed in directions opposite to what they are thinking.

Mr. Reinecke. I thank you for that clarification and certainly commend you for the fine job you are doing.

Mr. Rogers of Florida. Mr. Hathaway?

Mr. Hathaway. Thank you, Mr. Chairman.

Just one question, Dr. Wenk. First of all, I would like to commend you on your excellent statement. I wonder if you had given any thought to the suggestion that has been made—in fact, Senator Muskie and I have both introduced bills—to establish a Cabinet-level department on space and oceanography.

Would you like to comment on that?

Dr. Wenk. This gives me an opportunity also to come back to the question about the Council's interest in the issue of Federal reorganization. The act explicitly gives the responsibility for making recomendations to the Commission. The act, however, does say that the Commission's recommendations go to the President via the Council.

It is for this reason that the Council is going to be obliged to think through the alternatives, one of which—in fact, I believe the only one on the books at this session of Congress—concerns a possible Cabinet-level department proposed by Mr. Hathaway.

The Council has up to this time given no consideration to this question of Federal reorganization. At the moment we are concentrating our efforts on trying to meet the objectives of the legislation by strengthening overall activities with the ongoing array of Federal agencies, by helping each of them to do their job.

At some date, and this will not be too far off, we are going to have to think through this organization question, so as to be prepared to receive the recommendations of the Commission. The initiative and the number of alternatives that will be considered we feel to be more the Commission's job than it is that of the Council.

Mr. Hathaway. Thank you very much.

Thank you, Mr. Chairman.

Mr. ROGERS of Florida. Mr. Edwards?

Mr. EDWARDS. Dr. Wenk, to what extent has the Council been involved in the sea grant college program?

Dr. WENK. The sea grant program was established as an amendment to the original Marine Resources and Engineering Development Act. This was done because even though the legislation gives the authority to the National Science Foundation to administer the sea grant program, it gives the responsibility for policy guidance to our Council.

Last fall, soon after the Council was activated, working closely with the National Science Foundation, we endeavored to develop a set of criteria, on which basis awards for sea grants could be made. These criteria were developed over a period of 3 or 4 months and find their way, in fact, to a chapter in this report of the President, although they are not explicitly identified as such.

Mr. EDWARDS. Page 57?

Dr. WENK. That is correct. On the bottom of page 60 and the top of page 61 is essentially an abstract of the nature of a sea grant program that we visualized arising from this legislation. On page 62 and page 63 are set forth a set of criteria on the basis of which the applications from potential recipients of the grants would be evaluated.

This broad guidance—and it is broad—was provided the National Science Foundation and worked out with them. It was my understanding that at the present time they are converting these broad terms into an explicit announcement, that will be made available within the next week or so.

Mr. EDWARDS. Do you feel, then, that the sea grant program is going forward as you would hope and that it is going in the right direction?

Dr. WENK. Well, it's a little early to tell how this is working. No grants have yet been awarded. Authorization Congress provided in the act required a cycle of appropriations in order to implement the legislation.

The administration on its own initiative proposed to reprogram $1 million of fiscal 1967 money already appropriated, but this required informal approval of the Appropriations Committee; this was obtained about 6 weeks ago.

The National Science Foundation for fiscal year 1968 has $4 million earmarked for the sea grant program.

The House in passing the NSF appropriations this year went on record explicitly supporting this sea grant program, and indicating that any cuts that it proposed to the NSF should not be taken in this sector.

Mr. EDWARDS. In other words, we went along with the $4 million?

Dr. WENK. You went along with the $4 million and, in fact, protected it rather uniquely in comparison with other parts of the NSF program.

It is my understanding that the Senate within the past few days has acted similarly. This appropriation will be resolved in conference very, very shortly and I am sure signed into law.

Mr. EDWARDS. Thank you, Mr. Chairman.

Mr. ROGERS. Dr. Wenk, I want to join in saying that I think your statement has been most helpful. There are some questions, however, that I would like to get into, if I may, to be rather more specific on what the Council is doing.

For instance, how many contracts have been entered into, and what types of contracts? Could you give us a quick résumé of what is being done, how these are decided, who makes the decision to grant them, are they reviewed by the members of the Council, and the time periods involved?

Dr. Wenk. Mr. Rogers, why don't I get over this briefly and then submit more details for the record?

(The information follows:)

COUNCIL STUDY CONTRACTS

Subject	Contractor	Date of award	Amount	Completion
A study of international legal problems concerning living resources of the sea.	Paul W. Dodyk, Columbia University School of Law 435 West 116th St., New York, N.Y.	Apr. 10, 1967	$7,425	Oct. 7, 1967
Organize a seminar of the liability aspects of activities in the marine environment; record, edit, and reproduce the proceedings of the seminar.	American Trial Lawyers Association, Kraindler & Kraindler, 99 Park Ave., New York, N.Y.	May 29, 1967	1,000	June 28, 1967
A study of legal problems arising out of the management, use, development, recovery, and control of the marine resources along the coasts of the United States.	Albert Garretson, New York University School of Law, New York, N.Y.	May 24, 1967	20,000	Feb. 1, 1968
A study of legal problems arising out of the management, use, development, and recovery of natural resources of the Great Lakes aera of the United States.	Board of Regents of the University of Wisconsin, Madison, Wis.	June 16, 1967	20,000	Nov. 1, 1968
National data program for the marine environment.	Systems Development Corp., Santa Monica, Calif.	June 28, 1967	75,000	Nov. 15, 1967
To collect and evaluate economical and industrial statistics on marine resources and engineering development.	Surveys & Research Corp., 1030 15th St. NW., Washington, D.C.	Dec. 19, 1967	6,400	Jan. 31, 1967
A study of areas of legal conflict of immediate concern.	William L. Griffin, 1725 DeSales St. NW., Washington, D.C.	Feb. 6, 1967	4,200	Apr. 7, 1967
Report of achievements and problems of the International Indian Ocean Expedition and recommendations for the improvement of future expeditions.	Robert G. Snider, 112 West Foster Ave., State College, Pa.	Mar. 2, 1967	6,000	May 2, 1967
A study of the international legal problems involved in the scientific exploration and investigation of the marine environment and its resources.	William T. Burke, Ohio State University, 1659 North High St., Columbus, Ohio.	Apr. 4, 1967	7,100	Sept. 1, 1967
A study of the international legal problems involved in the management, use, development, recovery, and control of the mineral resources of the marine environment.	Louis Henkin, Columbia University School of Law, 435 West 116th St., New York, N.Y.	Apr. 7, 1967	10,000	Oct. 4, 1967
Nonmilitary needs for underwater technology.	Southwest Research Institute San Antonio, Tex.	June 29, 1967	63,000	Nov. 15, 1967
Systems analysis of the U.S. fishing industry.	Litton Industries Transportation Systems Marine Technology, Inc., Beverly Hills, Calif., subcontractor, Litton Industries Mellonics Division, Sunnyvale, Calif.	June 28, 1967	89,373	Do.
Potential of aquiculture for providing food from the sea.	American Institute of Biological Science, 3900 Wisconsin Avenue, Washington, D.C.	June 30, 1967	30,756	Oct. 31, 1967
The potential of observation of the oceans from spacecraft.	General Electric Missiles and Space Division, Valley Forge, Pa.	do	59,433	Oct. 30, 1967
Multiple use of the waters and coasts of the Chesapeake Bay.	Trident Engineering Associates, Annapolis, Md.	June 27, 1967	27,254	Mar. 1, 1968
Competing demands for land and water use in the Greater Seattle Harbor.	Management and Economics Research, Inc., Palo Alto, Calif.	June 30, 1967	35,235	Feb. 29, 1968
Economic potential of selected resources of the U.S. Continental Shelf and slope.	Economic Associates, Inc., 1150 Connecticut Avenue NW., Washington, D.C.	do	55,000	Dec. 30, 1967
The encouragement of private investment enterprise on marine resources and engineering development (this is a cooperative study with the National Science Foundation).	National Planning Association, 606 New Hampshire Avenue NW., Washington, D.C.	June 30, 1967	75,057	June 30, 1968

Dr. Wenk. The purpose of all of these contracts was to provide background information on how the sea is to serve national goals and I will elaborate on this.

In each case we felt we needed information that would help us in providing to the President for fiscal year 1969, recommendations as to areas that deserve long-term priority attention. As a consequence, all of these contracts are small in amount of money and short in time.

Preliminary reports are already in from all of these, and the final reports, with only one or two exceptions, are due this fall.

The contracts cover the following areas and I will list these quite briefly and then go back to the mechanism for their selection.

In the first instance, we have a major study on the national requirements—not just Federal but non-Federal as well—for oceanographic data; on the present techniques by which data are collected and the present network for the dissemination of data. This study thus leads to the question of how to improve the system.

The second study concerns the unmet needs for underwater technology in civilian fields. The Navy has been the leader in development of underwater technology, but specifically oriented to security needs. We have come to understand that there are civilian activities in the sea which will require new engineering development, will require compact powerplants, or may require better navigation, materials more resistant to corrosion, and so on, that may not be met.

In the absence of any central source of this information, we have a contract to collect and identify these needs, especially to identify needs that may be identical in several different fields and which would, therefore, warrant priority support for engineering research.

A third contract concerns a systems analysis of U.S. fishing industries. Here is a case where we recognize that this industry has not had the economic viability of many of our other industries, has not benefited from the introduction of modern technology. We are trying, through this contract, to study the entire system from fish in the sea to some product in the marketplace; to understand at each step along the way whether more research could increase the effectiveness of the fishing operation or reduce costs. We are looking at fish finding, fish mapping, fishing gear, fish processing, including this question of large ships, stern trawlers, and other new techniques, and also this question of how you pass the threshold from the fish on the dock to the fish in the marketplace.

Another study concerns what has been called aquiculture, which is developing food from the sea by deliberate artificial means. This is something we do in a fish hatchery all the time, but not usually for commercial production. Many countries, however, have done this with regard to fish, shellfish, and seaweed. This study will produce a handbook of what is going on elsewhere in the world from which we can learn some lessons domestically and maybe identify new steps related to the broader food-from-the-sea objective.

Another contract concerns the potential of observations of the ocean from space. Most of our spacecraft in orbiting the earth spend roughly three-fourths of their time over the oceans. This provides opportunities to take photographs, to take other measurements, perhaps with infrared sensors by which we can collect data about the whole ocean faster and more economically than might otherwise be possible.

Spacecraft may also be useful as radio stations to telemeter data from unmanned buoys to some central data collection center. This study should collect information now scattered around in dozens and dozens of reports to help us understand the question: "Will observations from spacecraft advance in the oceanographic field?" No new scientific research is being done. The only purpose is to synthesize what has already been done and try to put it in some orderly fashion vis-a-vis these objectives.

There are also two studies concerned with this problem of conflicting uses of the seashore that were touched on here earlier and we expect to have a third to cover three different situations: The first concerns a harbor, a dense urban development along the waterfront; the second concerns a bay and estuary complex; and the third concerns the Great Lakes.

Two of the contracts have been let. The first with regard to a typical bay and estuary, uses the Chesapeake Bay as an example.

Another contract study concerns the economic potential of selective resources of the Continental Shelf. The purpose of this contract is to collect in one place everything that is known either in the Federal Government or outside of the Federal Government about the existence of resources on the Continental Shelf.

The first objective is to find out what more mapping needs to be done, to find out what areas have been intensively covered, what gaps may exist, and what techniques for mapping may be desirable.

The second purpose of the contract is to look ahead to this question of private development. We regard the development of resources offshore as an extension of activities onshore. These resources in the United States are developed by private initiative. The cost of developing these resources offshore, however, at the moment is higher than it is in most instances onshore and industry will not take the initiative to develop these offshore resources until the costs come into line.

The question we are asking is what artificial barriers exist because of legislation or otherwise that inhibit private development offshore and, secondly, what technological barriers exist that might be eased by federally sponsored research?

Lastly, there is a contract which analyzes various devices of the Federal Government that have been chosen in the past to encourage private development, to find out which succeeded and which failed. That is perhaps a dangerous question, because it admits perhaps that they all don't work, but we sincerely want to find out which really did and which did not succeed in stimulating private development.

The manner in which the contracts were selected was as follows——

Mr. EDWARDS. Excuse me. May I ask one question at that point? Do you have a contract that gets into the legal implications of exploring the sea?

Dr. WENK. Yes sir; we do. I did not cover these in this list. Three are for the international aspects concerned with marine resources. The first, with a Professor Burke at Ohio State University, is concerned with the legal problems of research in international waters; the second one is on problems of mineral resources and is with Professor Henkin of Columbia University; and the third, concerned with living resources, is with Professor Dodyk also at Columbia.

We have also had a small study contract with the American Trial Lawyers Association, to help them sponsor a symposium that was conducted at the Law of the Sea Conference in Rhode Island about 2 months ago and that is completed.

Mr. Rogers. Are there any other contracts that you have out?

Dr. Wenk. The other one with regard to the legal problems along the coasts—and I guess I mentioned this earlier—is with Professor Garretson at New York University. One with regard to the Great Lakes is being negotiated with the University of Wisconsin.

Mr. Rogers. Are there any other contracts in being or contemplated?

Dr. Wenk. Mr. Rogers, I believe that completes those that are in being. There are several that have been sponsored by the Commission and you can probably get those when you talk with them.

Mr. Rogers. Are they administered by the Commission?

Dr. Wenk. By the Commission; yes, sir.

Mr. Rogers. You have nothing to do with them?

Dr. Wenk. Nothing to do with them except that we have in understanding that the results of ours are available to them and vice versa.

Mr. Rogers. All right.

Dr. Wenk. With regard to the selection process, the first problem was to identify those issues deserving of this kind of attention. This took several months of study by our staff, in consultation with representatives from the Federal agencies and outside consultants, and we have made liberal use of outside consultants.

Mr. Rogers. Have you used the National Science Foundation or the National Academy of Engineering?

Dr. Wenk. Yes; we have.

Mr. Rogers. I know they offered their services. I wanted to know if you have used them.

Dr. Wenk. We have been in consultation with them. We have not assigned them an explicit problem, but we have been in continuing consultation with them. One of the members of my staff was present at the Academy of Engineering meeting on the west coast just about 2 months ago.

If I can digress for a second because of this point—it is our feeling that there are many ideas in organizations such as the Academy of Engineering and the Marine Technology Society and the National Security Industrial Association, and so on, that have not come to our attention spontaneously, though we have invited this kind of suggestion repeatedly.

Mr. Rogers. I had understood that these organizations had written letters to the President, saying they are available for use for the Council.

Dr. Wenk. There has been an exchange of correspondence between some of them and the Vice President, and this took place in the spring.

Mr. Rogers. In the beginning?

Dr. Wenk. Yes, sir. We are now writing another letter to the heads of every one of these organizations much more specifically urging that they bring to our attention the results of any studies that they have undertaken.

Mr. Rogers. I would hope that this could be used rather extensively by the Council, and perhaps you would even initiate specific requests that they do studies. As I understand, they are willing to do them for you if they are called upon.

I would hope the Council could make use of this. It seems to me that these would be two bodies that could be helpful.

Dr. **Wenk.** I absolutely agree. These particular contract studies were discussed with some of the members of the Academy of Engineering. They felt that this time scale that we have established is rather short for the kind of study that they could undertake.

Secondly, they thought that each one of these involved a collection of local specialists whereas they are covering a much broader field through their membership.

Mr. **Rogers.** Would you let us know when you make any requests to them or advise the committee on this? I think this would be helpful.

Dr. **Wenk.** I would be very pleased to, Mr. Rogers. Perhaps I could submit to you a copy of this letter that we are sending out, together with a list of all of the addressees.

Mr. **Rogers.** That would be helpful.

(The letter mentioned follows:)

SAMPLE LETTER

EXECUTIVE OFFICE OF THE PRESIDENT,
NATIONAL COUNCIL ON MARINE RESOURCES AND
ENGINEERING DEVELOPMENT,
Washington, September 12, 1967.

MR. THOMAS C. KAVANAGH,
Chairman, Council on Ocean Engineering, American Society of Civil Engineers,
New York, N.Y.

DEAR MR. KAVANAGH: On behalf of the Vice President and Members of the National Council on Marine Resources and Engineering Development, I should like to bring to your attention a brief report on the status of Council planning, and to indicate how welcome any comments or recommendations would be by your committee of the American Society of Civil Engineers.

As you know, the Marine Resources and Engineering Development Act of 1966, PL 89–454, established a major new National policy to intensify the study and effective utilization of the sea. The measure also created a cabinet-level policy planning Council, chaired by the Vice President, to assist the President in carrying out this mandate.

During its first year of operation, the Council has endeavored to determine how marine science efforts could contribute to national goals; to provide direction, momentum and coordination of Federal programs in some eleven departments and agencies; to identify priorities; and to strengthen cooperation between Federal and non-Federal interests.

The Council's first assignment was to draft for the President the report on "Marine Science Affairs" which identifies the scope and balance of the entire Federal Government's programs and special initiatives for Fiscal Year 1968. By way of background, I am enclosing a copy of the legislation, of the President's report, and of a recent progress report to the Congress.

Now the Council faces a new task—to define longer range concepts and goals; to strengthen the core program of existing activities, and to develop new policies and programs that would advance the Nation's progress in marine sciences toward objectives of the organic act.

We thus want to make sure that Council members and the participating Federal agencies have brought to their attention the best of new ideas and insights as to promising paths of broad technological development and policies that would foster such advances from all interests throughout the country—state and local, industrial, academic and professional. To that end, we look forward to gaining the benefit of guidance from specialists represented by your organization, in relation to the Council's responsibility for developing comprehensive plans for marine science affairs.

May I suggest that you consider this letter an invitation to communicate views appropriate to our planning this fall for Fiscal Year 1969—that incidentally will have a significant effect on developments for almost the next two years—but also an open invitation for suggestions in a longer range time scale.

May I also take this opportunity to say how very important we regard activities of your organization in bringing to its professional members the fruits of engineering research that may aid their practice and as well advice and guidance to those of us in Government.

Sincerely,

EDWARD WENK, Jr.

List of Professional and Industrial Organizations to whom letters were addressed inviting recommendations regarding the Federal Government's program in marine sciences:

Academy of Underwater Photographers.
American Geological Institute.
American Institute of Biological Sciences.
American Society of Limnology & Oceanography.
American Society for Oceanography.
Institute of Navigation.
International Oceanographic Foundation.
Marine Technology Society.
National Academy of Sciences Committee on Oceanography.
National Academy of Sciences Committee on Ocean Engineering.
Underwater Society of America.
The Institute of Electrical and Electronics Engineers, Inc.
National Security Industrial Association.
Maritime Trades Department, AFL–CIO.
Aerospace Industries Association of America, Inc.
Hayden, Stone, Incorporated.
American Bar Association.
American Society of Civil Engineers.
American Society of Mechanical Engineers.
National Oceanography Association.
National Association of Manufacturers.
Council of Oceanographic Laboratory Directors.
American Petroleum Institute.
American Mining Congress.
Society of Naval Architects and Marine Engineers.

Mr. ROGERS. Let me ask you how many are on the staff of the Council. How many people do you have to help you on your staff?

Dr. WENK. The total staff allowance by the Bureau of the Budget is 20. Of these, if I recall correctly, 11 are professional and nine are secretarial assistants.

Mr. ROGERS. Can you call on the various departmental people to come in and help on specific problems if you need them?

Dr. WENK. Indeed we can and do.

Mr. ROGERS. I notice one of your staff members that I have known is Glenn Schweitzer. I commend you for your good choice. I know his background and think he is an excellent member for you to have.

Dr. WENK. I appreciate that. I know he appreciates your comments.

We have been enormously pleased to have the Secretary of State's concurrence on Mr. Schweitzer joining us. We have wanted a multidiscipline approach. We have lawyers and economists and Mr. Schweitzer is a foreign affairs specialist.

Mr. ROGERS. Let me ask you about getting into these contracts. What procedure do you use? How did you decide who is most qualified to carry out these contracts? Would you let us know who is doing each contract?

Dr. WENK. I can add this information to the list.

In the first instance, we tried to identify these problem areas deserving of priority attention, and this was done in consultation with the agencies and outside consultants.

Secondly, we tried to identify a list of qualified bidders, then invited bids from this selected list.

The response that we had in some instances was good; in some instances there were very few bidders, and in one or two cases there were none. Some of the contracts not yet awarded, as a matter of fact, result from this problem. In any event, virtually all of these were done on a competitive basis.

We then had a selection team made up of representatives from those agencies that would be obliged to implement whatever findings occur from the contracts so that we wanted to make sure they were partners in this enterprise from the beginning.

Mr. ROGERS. So selection was not made only by the staff of the Council?

Dr. WENK. Not at all.

Mr. ROGERS. This is the point I wanted to determine. You might give us some examples of this for the record, not now, as to who made the selections on the various contracts. I think this might be interesting for the committee.

(Information follows:)

THE AWARD OF MARINE SCIENCES COUNCIL CONTRACTS: A CASE STUDY

Contract: A Comprehensive Study on a National Data Program for the Marine Environment, Phase I.
Contractor: System Development Corporation, Santa Monica, California.
Period: June 28–November 15, 1967.
Cost: $75,000.

Traces of concern for the effective management of marine sciences data, although detectable several years ago, were first brought into focus by the Panel on Oceanography of the President's Science Advisory Committee. The Panel's report in June 1966, noted that "despite determined efforts of the NODC staff, quite clearly the Center falls far short in meeting demands of users" and recommended "a study—to determine means for improving existing services and for broadening and extending the scope and versatility of services in response to a wide spectrum of user requests."

In response to the Panel's recommendation and in consultation with agency representatives and Council consultants, a proposal for a comprehensive marine data management study was presented to the Marine Sciences Council at its third meeting, October 27, 1966. The Council accepted the proposal, with the Vice President requesting Council staff to develop details, taking into account the activities and interests of the agencies concerned.

Thereafter, a Data Management Advisory Panel was formed with representatives of ten agencies as members and Dr. F. J. Weyl, Special Assistant to the President of the National Academy of Sciences, as Chairman. During the next six months the Panel met seven times to review a complex set of agency requirements and to draft comprehensive study specifications which were forwarded to 167 private companies and corporations on May 15th. A bidder's conference was held in Washington, D.C. on May 24th for purposes of thorough analysis and explanation of the specifications.

Subsequently, proposals were received from 23 firms. During the period June 6–14 the Interagency Data Management Advisory Panel, augmented by additional specialists from those agencies having major oceanographic data functions, formally evaluated the proposals in a screening and scoring process involving 74 questions. This process narrowed the choice to two firms with proposals of high but essentially equal merit.

In the final stage of the decision-making process, technical presentations were made by representatives of each of the two firms to members of the Interagency Data Management Advisory Committee and Council staff on June 20th. Based on a secret ballot taken following these presentations and a review of decisions at each step by the Executive Secretary of the Council, the study contract was awarded to System Development Corporation on June 28, 1967.

Mr. ROGERS. Give us the time element, if you could, for the record on these studies, when they have been done and when they are due and so forth.

I had heard that there was some complaint—and I don't know how justified it is—from industry that many of the study contractors are passing out questionnaires with the very same questions on them. Have you run into this at all?

I presume there could be some overlap on the questioning. I don't know to what extent this is being done. Have you heard this?

Dr. Wenk. No, sir; I had not heard that complaint and the first thing I am going to do is find out if there is some validity to this.

Mr. Rogers. I don't know that there is. This is the complaint I had heard, that there was some overlap. It might be something that you ought to look into.

(The following information was submitted in response to the above:)

We know of no duplication in the questionnaires sent to industry under either Council or Commission contracts. We are now checking all Contractors and have asked them to hold up any new requests until we have checked. We have also notified the Commission so that they may check their contracts.

Mr. Rogers. What has been done by the Council to encourage private industry's effort in the field?

Dr. Wenk. To answer that question, I would like to point out that industry might be thought of as divided into two different categories. The first would be the high technology industry that develops instruments, deep-diving submarines, communications equipment, and so on. The second is a sector of industry dealing with the resources of the sea—oil and gas, minerals extraction and fishing, shipping and so on.

I distinguish between the two because I believe their role here is somewhat different, although I hope harmonious, as between the two sectors of industry itself. At the moment because we have been in business a relatively short time, I don't believe that I could say that there has been a major development to involve industry any more actively than has been the case in the past, but we have tried to do two things.

First, we have tried to indicate how broad this field of marine sciences is. I have the feeling that people may have thought this was a rather narrowly specialized field which could be of interest only in very special ways. The same problem existed when this country first went into nuclear power. People thought that the only participants would be physicists. When we went into the space program for a while there was a similar concern even though everyone admitted that no one had ever been trained as a space scientist or technologist.

There is a little of that problem here and I believe we have tried to broaden the understanding of industry so that they can see their own role.

The second thing we have tried to do is to excite industry to submit new ideas. These contracts that we mentioned earlier provided an explicit opportunity for industry to come to us with ideas and it also suggested to them by the very topics those that might be most promising at this stage of review, which could in turn encourage them to go back and perhaps do some in-house study and as time goes on, come in to the Government with more unsolicited proposals.

Mr. Rogers. Do you feel that industry has responded sufficiently?

Dr. Wenk. No, sir; I do not.

Mr. Rogers. Let's be frank now.

Dr. Wenk. To be frank, I do not and I have already gone on record on this publicly. In addressing the Aircraft Industries Association just about 3 months ago I was asked that very question, Mr. Rogers, and I had to be candid and say, no, I did not think that industry had responded to the extent that one would have expected at this point.

Mr. Rogers. Well, I think this is good for you to be frank and I think this is part of the function of the Council, to try to stimulate industry to come in, because we want this to be a program by which primarily American industry will benefit; and it primarily will be American industry that is going to benefit.

Any suggestions the Council would have I think this committee would be pleased to have, and perhaps during our hearings we can have industry people in to see why there has not been a proper response.

To what do you attribute it?

Dr. Wenk. In the first instance, it is a little bit hard to know what kind of response one should look forward to here, and in making these comments I certainly do not want to be critical of the contributions that industry has made. It is, in fact, quite the other way.

My own feeling is that a lot of people have felt that this program was another space program and it is not. It is very different from our space program for a number of reasons.

First of all, this is one in which we expect private industry to be involved; developments in the future are not going to be almost entirely from the Federal Government.

Mr. Rogers. Well, the reason for that is, isn't it, that we feel an immediate economic benefit can come out of the sea to sustain industries' activities?

Dr. Wenk. Precisely.

Mr. Rogers. This is what we are trying to show and develop, where they can get an economic benefit, in order to encourage their participation?

Dr. Wenk. And this economic benefit includes not only the development of the ocean resources off our shores, but it recognizes that because of the technological lead this country does enjoy, we are therefore able to work in other nations in developing their resources. This is an area of, you might say, an export of technology that we have not recognized previously.

The second reason why this isn't quite like the space program is because the Federal interests in the sea come from a variety of different agencies that have not had the same experience in working with this high technology industry as the Department of Defense and NASA have.

I believe that this is a case where industry in looking to the Department of Commerce, the Department of the Interior, the Department of Transportation, AID, and other areas of the Federal Government, will be approaching their role perhaps a little differently than in terms of the past style of relationships with DOD and NASA.

We must look to industry for ideas and we must look to them for the entrepreneurship in carrying out this program. There is no alternative. I know I am speaking personally in this regard, but I just don't believe that the Federal Government should be the only sponsor of this kind of activity in the sea.

Mr. Rogers. I would agree. I think we are going to have to spearhead some of the research work, some of the work that needs to be done, but that the Navy is doing, for instance. I am concerned. I am not sure that the Department of Defense has been impressed and I think here again is where the Council can come in and be effective with the Vice President as its Chairman, in vesting to the Secretary of the Department of Defense the need for the development of this deep search vessel, the salvage vessel.

From my undrstanding there is some concern as to the emphasis being placed on this by the Department of Defense. I think the Navy is placing the emphasis, but I am not so sure that the Department of Defense is placing the proper emphasis. What would be your comment on that?

Dr. Wenk. First of all, the Navy is the major sponsor of research and development in the sea. Fifty-eight percent of the total Federal program comes from the Navy. This is oriented toward the Navy's immediate needs, but there is a very substantial part of the research they do that benefits the other agencies and benefits industry.

We can show these benefits clearly. One of the most beautiful examples I know is the navigation satellite. This was developed by the Navy in reference to its fleet ballistics missile program, but with its evolution the opportunity developed to declassify this program.

With initiative from the council just about 2 months ago there was concurrence from the Department of Defense to make it possible for industry in the United States to manufacture and make available for sale in the United States the receivers necessary to tune in on that navigation satellite. This is going to help our merchant fleet. It is going to help people doing oceanographic research who need to know their positions far more accurately and it is going to help the offshore oil industry, because they must know their location precisely.

This is an example where a piece of apparatus designed entirely with Navy funds and without a single other Federal dollar going into this can be made available to other parts of our society.

Mr. Rogers. I am concerned about this search vehicle. I understand the contract has not been let. It was supposed to be in October, but now I understand it may be November or budgetary problems may come into the picture.

Here is an area where I think we can be helpful to industry by developing such a vehicle and bringing about the technique of knowing about the fuel system that we use, all about the buoyancy, the propulsion and how deep we can go and then, of course, the other program where you have salvage. Certainly that can be geared toward industry very simply if we have a vehicle and the capacity to go down and salvage, and certainly we should have learned our lessons by the *Thresher* and the atomic bomb off Spain. We need to develop these programs, and we have not yet done it.

I realize that this is a primary function of the Department of Defense and Navy in this particular field, but I think it is of such importance to the overall field of oceanography that the council must give some impetus and put some pressure in the right places to see that the emphasis is given to these programs.

I wanted your feeling and the feeling of the Vice President perhaps on this.

Dr. Wenk. You put your finger on an area in which the council has taken an explicit interest—in this matter of a deep sea capability, in full recognition of the *Thresher* disaster and also the lost but later recovered unarmed nuclear weapon off Spain.

Both of these events pointed out the fact that this country does not have the capability of search and salvage and this gave impetus to this program.

I do not have its present fiscal status at my fingertips, but I assure you I will communicate to the council and to the Vice President your concern about this.

Mr. ROGERS. Will you let the committee know what steps you think should be taken to be helpful in these programs?

Dr. WENK. Surely.

(The information follows:)

STATUS OF DEEP SUBMERGENCE SEARCH VEHICLE

The following information has been provided by Department of the Navy staff in response to Congressman Roger's question about the Deep Submergence Search Vehicle:

The Navy is negotiating the competitive design contract for a DSSV and this contract will be awarded this fall. The Navy would not award such a contract without the intention of a least completing a prototype DSSV.

The Navy has not yet received their Congressional appropriation for the DSSV. At the present stage of developing the budget, $9 million have been deferred from the Navy's deep submergence program. Such deferrals are not unusual in this or any other fiscal year and are frequently made pending a more detailed program definition and/or description.

Mr. ROGERS. I think it is urgent to get this capability. This will be the basis for industry's participation to a great extent, I think.

What would you say is probably the greatest need in oceanography right now? I realize this is a very broad question, but, to give it the greatest impetus, what do you think is needed?

Dr. WENK. That is a difficult question.

Mr. ROGERS. Would you rather submit that for the record?

Dr. WENK. I have an offhand impression and that there is not broad enough understanding of how important the seas are to our national interest. There has been a sort of "gee whiz" fascination with it, but that can be superficial and it can be temporary and it does not reveal the much deeper historical interests that this country has had in the sea and the gaps that now exist in terms of understanding the sea and in utilizing it in our national interest.

Somehow or other I feel that this understanding is not quite as broad or deep as the situation warrants.

Mr. ROGERS. I think that is a pretty good summary of the greatest need. I think this is true.

Although we have developed greatly an understanding of the need for the development in the field of oceanography, I think still we have not yet developed the urgency of the need for development and I am hopeful that this committee and the Congress can be helpful in doing this. Certainly the Council can exert a great deal of leadership, which I know you are trying to do, but I hope the Council will do even more in this area.

Dr. WENK. I appreciate your comments. In turn, the Vice President, as you know, has said that he is pleased that, even though there is no explicit legislation before your committee, that you have taken the time to look at this question 1 year after the Council was established. It is this kind of a step which does help gain some broader understandings of the problems.

Mr. **Rogers.** I agree that this is a vital function of the committee, and this was the idea of Chairman Lennon in setting these hearings. Counsel may have a few questions.

Mr. **Drewry.** Dr. Wenk, in our committee report on S. 944 there was discussion on page 12 of a relationship of the Federal Council for Science and Technology and the Interagency Committee on Oceanography. You may recall that in one of the stages of the development of the legislation we wanted to write in specifically that the ICO would work with the Council. The Bureau of the Budget, I believe, said—

> Please don't try to do that, because the President has his own way of handling things and they are under him and we will work with them.

Then we went on to emphasize that we had the hope and expectation that in the planning and the conduct of the program the President would, in fact, utilize and indeed strengthen the functioning of the Federal Council and the Interagency Committee on Oceanography.

I have heard that there has recently been some reorganization. But mainly my question is, "What is the relationship between the Council, the ICO, and the Federal Council, if any, now in view of the change that has developed in the law?"

Dr. **Wenk.** Very soon after the Marine Sciences Council was established—within a matter of days—there was consultation between the Vice President; Dr. Hornig, who chairs the Federal Council for Technology; Dr. Frosch, who chairs the Interagency Council on Oceanography; and myself. There was complete agreement that the ICO should assist the new Council in any way possible, and arrangements were made to do this.

After 8 to 10 months of operating experience we found several changes were needed. First of all, the terms of reference of the ICO were somewhat obsolete. These terms of reference had been set in 1961 under a different set of situations with a scope of program far more limited than we now see is true with marine sciences.

Secondly, this seemed to be an unnecessarily complicated system of having the ICO, under another coordinating council, the Federal Council, when in fact the unit they were serving was ourselves. The end result was a resolution just about a month ago by which the ICO was reconstituted and replaced by a set of different committees of the Marine Sciences Council. One of these deals with those activities that the ICO had been doing most of its life; marine research education and facilities, and continues to be chaired by the Assistant Secretary of the Navy, Robert Frosch.

Many of the staff of the ICO will continue to be engaged either as staff to that committee or direct staff to our Council.

The other committees are newer. One of these has been established by the Secretary of State, chaired by the Deputy Under Secretary, Foy Kohler, and I should like to take this occasion to commend the initiative and activity of that group in undertaking its role.

The other three committees are chaired as follows: the first one on exploration and environmental prediction by Dr. Robert White, the Administrator of ESSA; a second one on the problems of conflicting uses of the seashore, chaired by Assistant Secretary Stanley Cain of Interior; and the last dealing with this food-from-the-sea program, for which AID has a major role, is chaired by a Mr. Herbert Waters, an administrative assistant to the Administrator of AID.

The attempt is to have a minimum committee structure to do the job, but I think you can see by the level of people who are chairing these committees that we are endeavoring to deal with the kind of policy and program issues that the committees, in turn, will bring to the Council as a whole.

Mr. Drewry. These committees are of the ICO and are working with you; is that right? I mean, is there still an Interagency Committee on Oceanography?

Dr. Wenk. There is no committee with that name. Each of these committees is appointed by the Vice President, with terms of reference set by the Vice President; the chairmen are appointed by the Vice President.

The functions of the ICO, if anything, have been enlarged rather than reduced. The same people who served on the ICO itself will be serving on this new committee chaired by Dr. Frosch. The staff will be used. The functions that were carried out by the ICO in preparing reports, such as, for example, this one on the scheduling of oceanographic ships throughout the country some months in advance, so that the scientists in other institutions will know of their existence—all of this will continue.

Mr. Rogers. I think it might be well for you to give us this outline for the committee as to the membership when you submit the contracts and all that.

Dr. Wenk. I would be pleased to.

(Information follows:)

Executive Office of the President,
National Council on Marine Resources and Engineering Development,
Washington, September 21, 1967.

Committee on Marine Research, Education and Facilities

MEMBERSHIP

Hon. Robert A. Frosch (Chairman), Assistant Secretary of the Navy for Research and Development, Department of the Navy, Washington, D.C. 20350.

Mr. Herman Pollack, Director, International Scientific and Technological Affairs, Department of State, Washington, D.C. 20520.

Dr. Werner A. Baum, Deputy Administrator, Environmental Science Services Administration, Washington Science Center, Rockville, Maryland.

RADM O. R. Smeder, Chief of Research and Technology, U.S. Coast Guard, Department of Transportation, Washington, D.C. 20590.

RADM Odale D. Waters, Jr., Oceanographer of the Navy, U.S. Naval Oceanographic Office, Washington, D.C. 20390.

Mr. Daniel Hunt, Jr., Special Assistant to the Director, National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550.

Mr. Arnold Joseph, Marine Scientist, Environmental Science Branch, Division of Biology and Medicine, U.S. Atomic Energy Commission, Washington, D.C. 20545.

Dr. William T. Pecora, Director, U.S. Geological Survey, Washington, D.C. 20242.

Dr. Leon Jacobs, Deputy Assistant Secretary for Science, Office of the Assistant Secretary for Health and Scientific Affairs, Department of Health, Education, and Welfare, Washington, D.C. 20201.

Dr. I. E. Wallen, Head, Office of Oceanography and Limnology, Smithsonian Institution, Washington, D.C. 20560.

Mr. Leonard Jaffe, Director of Space Applications Programs, National Aeronautics and Space Administration, Washington, D.C. 20546.

OBSERVERS

Dr. Walter Baer, Office of Science and Technology, Washington, D.C.
Mr. Richard A. Rettig, Bureau of the Budget, Washington, D.C.

Committee on Ocean Exploration and Environmental Services[1]

MEMBERSHIP

Hon. Robert White (Chairman), Administrator, Environmental Science Services Administration, Department of Commerce, Washington, D.C.

Dr. J. Wallace Joyce, Deputy Director, Office of International Scientific and Technological Affairs, Department of State, Washington, D.C.

Capt. J. A. Hodgman, Office of the Chief of Staff, U.S. Coast Guard, Department of Transportation, Washington, D.C.

Dr. A. P. Crary, Deputy Division Director, Division of Environmental Science, National Science Foundation, Washington, D.C.

Mr. Donald I. Gale, Military Applications Division, Atomic Energy Commission, Washington, D.C.

Dr. S. Fred Singer, Deputy Assistant Secretary for Water Pollution Control, Department of Interior, Washington, D.C.

Dr. William Aron, Deputy Head, Office of Oceanography and Limnology, Smithsonian Institution, Washington, D.C.

Mr. Leonard Jaffe, Director, Space Applications Program, Office of Space Science and Applications, National Aeronautics and Space Administration, Washington, D.C.

Capt. Louis DeCamp, USN, Assistant Oceanographer for Operations, Office of the Oceanographer, U.S. Navy Oceanographic Office, Suitland, Md.

OBSERVERS

Dr. Walter Baer, Office of Science and Technology, Washington, D.C.
Mr. James M. H. Gregg, Bureau of the Budget, Washington, D.C.
Dr. John Carlson, Council of Economic Advisers, Washington, D.C.

Committee on Food From the Sea

MEMBERSHIP

Mr. Herbert J. Waters (Chairman), Assistant Administrator for War on Hunger, Agency for International Development, Washington, D.C.

Mr. Donald L. McKernan, Special Assistant to the Secretary for Fish and Wildlife, Department of State, Washington, D.C.

Dr. J. L. McHugh, Deputy Director, Bureau of Commercial Fisheries, Department of Interior, Washington, D.C.

Dr. Leon Jacobs, Deputy Assistant Secretary for Science, Department of Health, Education and Welfare, Washington, D.C.

OBSERVERS

Dr. William Aron, Deputy Head, Office of Oceanography and Limnology, Smithsonian Institution, Washington, D.C.

Mr. Peter Dorner, Council of Economic Advisers, Washington, D.C.

Dr. Robert Milch, Office of Science and Technology, Washington, D.C.

Committee on International Policy in the Marine Sciences

MEMBERSHIP

Hon. Foy Kohler (Chairman), Deputy Undersecretary, Department of State, Washington, D.C.

Mr. Herman Pollack (Vice Chairman), Director, International Scientific and Technological Affairs, Department of State, Washington, D.C.

Hon. Robert A. Frosch, Assistant Secretary, Department of the Navy, Washington, D.C.

Hon. Robert White, Administrator, Environmental Science Services Administration, Department of Commerce, Washington, D.C.

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[1] Committee membership current as of November 16, 1967.

Hon. Stanley A. Cain, Assistant Secretary for Fish and Wildlife and Parks, Department of Interior, Washington, D.C.

Hon. Philip Lee, Assistant Secretary for Health and Scientific Affairs, Department of Health, Education and Welfare, Washington, D.C.

Mr. Myron B. Kratzer, Director, Division of International Affairs, Atomic Energy Commission, Washington, D.C.

Dr. Sidney R. Galler, Assistant Secretary for Science, Smithsonian Institution, Washington, D.C.

Mr. Daniel Hunt, Jr., Special Assistant to the Director, National Science Foundation, Washington, D.C.

Mr. Gustav Ranis, Assistant Administrator for Programs, Agency for International Development, Washington, D.C.

Mr. Arnold Frutkin, Assistant Administrator for International Affairs, National Aeronautics and Space Administration, Washington, D.C.

Hon. M. Cecil Mackey, Assistant Secretary for Policy Development, Department of Transportation, Washington, D.C.

OBSERVERS

Dr. Herbert Scoville, Assistant Director, U.S. Arms Control and Disarmament Agency, Washington, D.C.

COMMITTEE ON MULTIPLE USE OF THE COASTAL ZONE

MEMBERSHIP

Hon. Stanley Cain (Chairman), Assistant Secretary, Department of the Interior, Washington, D.C.

Mr. Donald L. McKernan, Special Assistant to the Secretary for Fisheries and Wildlife, Department of State, Washington, D.C.

Rear Admiral James C. Tison, Jr., Director, Coast and Geodetic Survey, Environmental Science Services Administration, Department of Commerce, Washington, D.C.

Rear Admiral Robert W. Goehring, Chief, Office of Operations, United States Coast Guard, Department of Transportation, Washington, D.C.

Mr. Joseph E. Upson, Deputy Assistant Chief for Research and Technical Coordination, Water Resources Division, Geological Survey, Department of the Interior, Washington, D.C.

Mr. James A. Lee, Assistant for Environmental Health to the Assistant Secretary for Health and Scientific Affairs, Department of Health, Education and Welfare, Washington, D.C.

Dr. John N. Wolfe, Division of Biology and Medicine, Atomic Energy Commission, Washington, D.C.

Mr. Robert Abel, Head, Office of Sea Grant Program, National Science Foundation, Washington, D.C.

Lt. General W. F. Cassidy, USA, Chief, Corps of Engineers, Department of Defense, Washington, D.C.

Dr. I. Eugene Walen, Head, Office of Oceanology and Limnology, The Smithsonian Institution, Washington, D.C.

Mr. Jack Carlson, Senior Economist, Council of Economic Advisers, Washington, D.C.

Mr. Ralph M. Cushman, Director, Facilities Management Office, Office of Administration, National Aeronautics and Space Administration, Washington, D.C.

DATA MANAGEMENT ADVISORY PANEL

MEMBERSHIP

Dr. F. Joachim Weyl (Chairman), National Academy of Sciences, Washington, D.C.

Dr. John V. Byrne, Oceanography Section, National Science Foundation, Washington, D.C.

Dr. J. Lockwood Chamberlin, Bureau of Commercial Fisheries, Washington Navy Yard Annex, Washington, D.C.

Captain James Hodgman, U.S. Coast Guard, Department of Transportation, Washington, D.C.

Dr. Woodrow C. Jacobs, Director, Environmental Data Service, Environmental Science Services Administration, Department of Commerce, Washington, D.C.

Mr. Arnold B. Joseph, Environmental Sciences Branch, Atomic Energy Commission, Washington, D.C.

Mr. C. B. Kelly, Chief, Research & Development, Water Supply and Resources Program, Public Health Service, Department of Health, Education and Welfare, Washington, D.C.

Mr. Bill Long, Science Information Exchange, Smithsonian Institution, Washington, D.C.

Captain T. K. Treadwell, U.S. Naval Oceanographic Office, Department of the Navy, Washington, D.C.

Dr. James I. Vette, Goddard Space Flight Center, National Aeronautics and Space Administration, Greenbelt, Maryland.

OBSERVERS

Colonel Andrew Aines, Office of Science and Technology, Washington, D.C.

Dr. Thomas Austin, Director, National Oceanographic Data Center, Washington, D.C.

Dr. James I. Vette, Goddard Space Flight Center, National Aeronautics and ington, D.C.

Mr. Drewry. One other thing. Back around the 16th or 17th century, during the Spanish control of Central and South America in the early days there was a proposal to dig a canal across the isthmus. The subject got up into the hierarchy of the church. The Pope is reported to have said, "No; you can't do it because what God has joined, let not man put asunder."

So it was abandoned for quite a while thereafter.

Perhaps it has not yet been put asunder because of this lock-type system. Now there is serious consideration being given and studies being made by a Presidential Commission of the matter of a sea-level canal dug, perhaps, by nuclear means.

What I am interested in knowing is whether your group has addressed itself to the extent of any ecological programs or studies that are being made that would determine what the effect of this "sundering," when it takes place, might be.

Here is a land bridge many, many millions of years old, separating two oceans, one of which has 20 feet of tide and one with 1½ feet. In addition to the matter of radiation pollution there is the question of the flow of water through there, the infusion of species from one ocean to another, the effect it might have on others, possibly even some climatic changes just by this.

I have heard concern expressed that though studies are being made, the extent of the potential damage from this vast project was not being looked at on a very broad scale. I wondered whether the Council had made any inquiry into the extent to which this is being done and who is in it, because I know that some studies are being made of the atmosphere, and the rainfall and some geophysical work is being done, but whether the type of thing that went into, for example, the Cape Thompson effort up in Alaska has been gone into, I don't know. I don't think it has.

Dr. Wenk. There has been no study as effective as the Cape Thompson study. That is true.

Our Council has not looked at this issue. We are aware of the Presidential Commission that has this responsibility in making recommendations. We are also aware of the ecological problems that could arise that you suggested. We have not taken this as an agenda item before the Council.

The fact that you raise the question is reason for me now to return and ask questions myself as to whether this might warrant attention by our Council.

Mr. DREWRY. You used the term "gee whiz" a while ago and the fact that we have the technology to blast a channel between two continents is something we say "gee whiz" about, but when we start messing around with nature, we don't know what is liable to happen.

We dug some channels to get into the Great Lakes and have been plagued to the tune of many millions of dollars to try to bring back the lake trout because of the depredations of the sea lamprey. Now we have the alewife problem there. I hope this is something that you might look into.

I have just one other short thing that is of interest to me and to the committee, and that springs from the reference in the Vice President's letter in which he comments on the fact that more than 90 percent by value of our intercontinental commerce travels by ship. Of course, I suppose by volume it would be 99 percent.

You also mentioned in your statement, I believe on page 2, the numbers of new research vessels which have been developed. Do you have any observations to make on the potentials of the use of our operating merchant marine which crisscrosses the world on regular schedules and trade routes as "ships of opportunity?" Have you considered the use that could be made of that fleet in the collection of marine environmental data on a worldwide and even a synoptic basis, if you wanted it that way?

It has been tried a little bit, but the thought has been expressed that if the possibilities are worth it, why not embody into each new ship that comes along such sensors or other probe systems as might be effective in this type of data collection.

Do you have any comment on the so-called "ship of opportunity"?

Dr. WENK. I think it has been largely the interest of this committee that has caused the Government in many different agencies to look at this question.

This, as I recall, dates back to hearings that you convened several years ago. Even before that, as I recall, some interest was stimulated in having the SS *Java Mail* of the American Mail Line carry out a complete set of experiments, showing the value and economy derived from this technique.

So far as I know, the major interest of the Government in this technique lies in the Navy itself. Most of the naval vessels in carrying out whatever explicit missions they have, carry with them equipment in the form of expendable bathythermographs which permit them to collect data while they are en route from one place to another.

Some 100 to 200 ships are doing this regularly. The data are being collected and collated. Some data in the Pacific, I believe, is being made available to the fishing fleet.

The Smithsonian at the present time is planning a program that possibly would involve equipping 12 ships with some equipment for the Pacific run. This is simply one of the areas that just has not gotten all of the attention and support that it might warrant and again with the question you have raised, I think we should go back and take a look at this.

Mr. DREWRY. I raised the question with this thought: That you talk about looking into survey requirements, and I believe you said you had a contract on this subject. It would seem to me that when you identify the areas in which you want to collect survey data on a regular basis—and after all, this is nothing but Commander Maury's concept of 150 years ago—it would be an area in which the merchant marine could make a major contribution to the United States and save one heck of a lot of money by virtue of being there and collecting data. With new instrumentation being built into the ships at the time the ships were built, it would be just about the cheapest way you could collect a tremendous amount of data when you found out what kind of data you really want.

That's all I have, Mr. Chairman.

Mr. ROGERS. Are there any other questions?

May I conclude with just a question. I have been a little disturbed about the movement of the sea-grant college program. I don't think that the National Science Foundation has moved it as rapidly as they should have.

I would hope the Council would look into that to see what has held this up. I think it has been slow in moving, so slow, in fact, that I would hope the Commission will look at whether this program should continue to be placed in the National Science Foundation in their reorganization proposals.

I certainly am going to look at it in that light if it doesn't get moving very rapidly. We appreciate your testimony on the work that the Council is doing. I think the committee does feel that you are doing an excellent job and we appreciate your testimony here today.

Dr. WENK. Thank you very much.

Mr. ROGERS. Thank you.

The committee will stand adjourned subject to the call of the Chair.

(Whereupon, at 12:10 p.m. the subcommittee adjourned, to reconvene at the call of the Chair.)

NATIONAL MARINE SCIENCES PROGRAM

THURSDAY, SEPTEMBER 14, 1967

House of Representatives,
Subcommittee on Oceanography of the
Committee on Merchant Marine and Fisheries,
Washington, D.C.

The subcommittee met at 10:15 a.m., pursuant to recess, in room 1334, Longworth House Office Building, Hon. Alton Lennon (chairman of the subcommittee) presiding.

Mr. Lennon. The meeting will please come to order.

The Marine Resources and Engineering Development Act of 1966 was signed by the President on June 17 of last year. It was the culmination of more than 7 years of work by the Congress. In addition to its carefully considered and worded declaration of policy and objectives, and delineation of executive responsibilities, it established in the Executive Office of the President, the National Council on Marine Resources and Engineering Development, a Cabinet-level body under the chairmanship of the Vice President.

Last month, on August 17, we were privileged to hear a report on the work of the Council from Dr. Edward Wenk, Jr., the able Executive Secretary of the Council.

One of the most important features of the 1966 act was the provision establishing a Commission on Marine Science, Engineering, and Resources, to be composed of 15 members appointed by the President, including individuals drawn from Federal and State governments, industry, universities, laboratories, and other institutions engaged in marine scientific or technological pursuits.

Provision was also made for the appointment by the President of four advisory members from among the Members of the Senate and House of Representatives.

The Commission's responsibility is to investigate and study all aspects of marine science in order to recommend an overall plan for an adequate national oceanographic program that will meet the present and future national needs.

The functions of the Commission are at the very core of the act.

On June 21, after the marine sciences bill had become law, I wrote to President Johnson expressing my gratification upon its enactment. I expressed my personal confidence, and that of my colleagues, that he would select as Commission members people of wide experience and specialized knowledge, able to spare the time to make a real contribution toward the objective for which the Commission was provided.

I commented that the conclusions and recommendation of the men who comprise the Commission would contribute greatly to the effectiveness of the broad national purposes contemplated by the act.

The President's response to the requirements of the act in regard to the establishment of the Commission has even exceeded our confident hopes that men of the highest qualifications and dedication would be appointed to this important body.

Mr. Mosher and I, as the two advisory members of the Commission from the House, can attest to this fact for we have had the opportunity not only to meet all of the members of the Commission, but to work with them and their regular sessions.

Our principal witness this morning, Dr. Julius Adams Stratton, is an outstanding example of a group of outstanding Americans who comprise the membership of the Commission on Marine Science, Engineering, and Resources.

Dr. Stratton's biography follows:

Mr. Stratton is one of the Nation's outstanding scientists and educators. He served on the faculty of the Massachusetts Institute of Technology from 1928 to 1951, in electrical engineering and later in physics. Subsequently, he served as an officer of the university in posts of increasing responsibility, culminating in appointment as President of MIT in 1959.

In 1966, after retirement from MIT, he was made chairman of the board of the Ford Foundation. Mr. Stratton has been a member of the National Science Board, trustee of numerous educational foundations, recipient of the Medal of Merit, the Faraday Medal, and the Medal of Honor of the American Institute of Radio Engineers. He currently resides in New York City. Dr. Stratton is accompanied by Dr. Richard A. Geyer, head of the department of Oceanography at Texas A. & M. University, who is Vice Chairman of the Commission; and Dr. Samuel A. Lawrence, who has a distinguished career in Government service, and is now Staff Director of the Commission.

At this point, Dr. Stratton, I would appreciate it if you would have Dr. Lawrence furnish for the record a biography, name, and identification; and a reasonably lengthy biography of each member of the Commission for insertion in the record at this point and without objection, gentlemen, I will ask that these biographies be included in the hearing record at this point.

(The biographies follow:)

BIOGRAPHIES OF MEMBERS, COMMISSION ON MARINE SCIENCE, ENGINEERING, AND RESOURCES

JULIUS A. STRATTON

Julius A. Stratton assumed the Chairmanship of the Board of the Ford Foundation in 1966 upon his retirement as President of the Massachusetts Institute of Technology, an institution with which he had been continuously associated since his undergraduate days. Born in Seattle on May 18, 1901, he spent one year at the University of Washington and then transferred to MIT, graduating with the Class of 1923. He studied abroad in 1923 and 1924 at the Universities of Grenoble and Toulouse after which he returned to MIT where he received his Master's degree in 1925. He was awarded the degree of Doctor of Science in Mathematical Physics by the Eidgenossische Technische Hochschule of Zurich in 1927 and followed this with study at the Universities of Munich and Leipzig on a traveling fellowship from MIT.

He joined the MIT faculty in the Department of Electrical Engineering in 1928 and subsequently became Professor of Physics, Director of the Research Laboratory of Electronics, Provost, Vice President, Chancellor, and, in 1959, President. He is now a Life Member of the MIT Corporation.

Dr. Stratton is a director of the Standard Oil Company of New Jersey and the Westinghouse Electric Corporation, and a trustee of Pine Manor Junior College and Vassar College.

He is a member of the National Academy of Sciences, the National Academy of Engineering, the American Philosophical Society, and a Fellow of the American Academy of Arts and Sciences, the Institute of Electrical and Electronics Engineers, and the American Physical Society.

He received the Medal for Merit from the Secretary of War in 1946, the Certificate of Award of the United States Navy (1957), the Medal of Honor of the Institute of Radio Engineers (1957), and the Faraday Medal of the British Institution of Electrical Engineers (1961).

RICHARD A. GEYER

Dr. Geyer is presently Head of the Department of Oceanography at Texas A&M University where he has been since 1966. Previously, from 1963–1966, he was Technical Director for Oceanography for Texas Instruments, Inc. From 1959–1963, he was a manager of Gravity and Magnetic Department of Texas Instruments, and from 1954–1959, he was Chief Geophysicist for the Gravity Department, Geophysics Services, Inc., of Texas Instruments. From 1945–1954, he was associated with Humble Oil and Refining Company, first as Senior Research Geophysicist and then Head of the Oceanographic Section from 1949–1954.

During World War II, Dr. Geyer served as Physicist in Charge of the Degaussing Range for the US Navy, Bureau of Ordnance, in Newport, Rhode Island, and as Senior Field Instructor at Woods Hole Oceanographic Institution at Woods Hole, Massachusetts. Before the war, from 1939–1942, he was an instructor at Princeton, and from 1938–1942, he did research in geophysics and geology for the Standard Oil Company in New Jersey.

Dr. Geyer was born on October 27, 1914, in New York City. In 1937, he received his BS from New York University; in 1940, he received his MS, also from New York University; and in 1950, he received his MA, and in 1951, his PhD from Princeton University.

Dr. Geyer is presently a member of the National Academy of Sciences Committee on Oceanography—Ocean Wide Surveys Panel and a member of the Board of the American Society for Oceanography and of its National Oceanographic Society. He was a consultant with the US Coast and Geodetic Survey and was formerly an editor of Geophysics.

DAVID A. ADAMS

Dr. Adams has served as Commissioner of the Division of Commercial Fisheries of North Carolina since 1963. Before that he was curator of the North Carolina State Museum from 1962–1963, chief Park Naturalist of the North Carolina Division of State Parks from 1957–1959, and a waterfowl biologist for the North Carolina Wildlife Resources Commission in 1957.

Dr. Adams was born in Lakewood, Ohio, on November 26, 1931. He attended the North Carolina State College where he received his BS in Wildlife Conservation and Management in 1953, his MS in Wildlife Management in 1957, and his PhD in Plant Ecology in 1962. He is the author of numerous professional publications and a member of several professional and honorary societies.

Currently, Dr. Adams is a member of the North Carolina Academy of Sciences, the Ecological Society of America, the American Institute of Biological Sciences, the American Fisheries Society, and Chairman of the South Atlantic Section of the Atlantic States Marine Fisheries Commission and Vice Chairman of the Atlantic States Marine Fisheries Commission.

CARL A. AUERBACH

Professor Auerbach has been a Professor of Law since 1947, serving at the University of Minnesota Law School since 1961, and before that at the University of Wisconsin Law School. In 1965, 1966 and 1967, he served as a visiting Professor at Columbia Law School, Utah Law School and Iowa Law School, respectively.

Professor Auerbach received his BA degree in 1935 from Iong Island University and his LLB from Harvard University Law School in 1938. Upon graduation from law school, he took a position as attorney in the US Department of Labor, where he served until 1940 when he moved to the Office of Price Administration as Assistant General Counsel. He served with the US Army in the OSS from 1943 until 1946 when he returned to the government as General Counsel in the Office of Price Administration and Associate General Counsel in the Office of the Economic Stabilization.

Professor Auerbach is the author of numerous legal articles and is the co-author of two books: "The Legal Process—An Introduction to Decision-Making by Judicial, Legislative, Executive and Administrative Agencies," and "The Federal Regulation of Transportation—Materials Illustrating Problems of Public Utility Control." He was also the recipient of a Fulbright Advanced Research Award in 1953, and from 1958–1959, he was a Fellow at the Center for Advanced Study in the Behavioral Sciences. He is also a member of the Division of Behavioral Sciences of the National Research Council.

Professor Auerbach has been a consultant to the Agency for International Development and the Staff Director to the Committee on International Organization and Procedure of the Administrative Conference of the United States.

CHARLES F. BAIRD

Mr. Baird was recently appointed Under Secretary of the Navy to succeed Robert Baldwin. He has served at his new post since August 1, 1967. Prior to his appointment, Mr. Baird served as Assistant Secretary of the Navy (Financial Management). Before assuming the post of Assistant Secretary, the majority of Mr. Baird's career was spent with Standard Oil Company (New Jersey) which employed him initially in 1948 as an analyst in the Treasurer's Department. Specializing in international finance questions, he occupied a series of executive positions in New York, London and Paris. From 1962 to 1965, he was a Member of the Executive Committee of Esso Standard S. A. Francaise, one of the largest companies in France. At the time of his nomination by President Johnson as Assistant Secretary of the Navy in November 1965, he was Assistant Treasurer of Standard Oil Company (New Jersey).

Mr. Baird served in the US Marine Corps from July 1943 until July 1946, including sixteen months in the Pacific as a Lieutenant with the 3rd Marine Division and in China with the 3rd Amphibious Corps. Recalled to active duty during the Korean hostilities, he served with the 2nd Marine Division from June 1951 until June 1952 in the rank of Captain.

Mr. Baird was born in Southampton, New York, on September 4, 1922. He attended Middlebury College where he majored in economics. Enlisting in the Marine Corps he was ordered, under the V–12 program, to Dartmouth College where he completed his senior year and was awarded a Bachelor of Arts degree by Middlebury. After the war, he studied at the New York University Graduate School of Business Administration, and in 1960, completed the Advance Management Program of the Harvard University Graduate School of Business Administration.

JACOB BLAUSTEIN

Mr. Jacob Blaustein, of Baltimore, Maryland, has been long active in public life. President Eisenhower appointed him a US Delegate to the United Nations. President Truman appointed him a member of the Mobilization Policy Board during the Korean War. President Roosevelt appointed him Consultant to the American Delegation to the United Nations Organization Conference in San Francisco in 1945. President Kennedy appointed him a Presidential Representative on the Board of Governors of United Service Organizations (USO), and as Consultant to the State Department on International Business Problems, to both of which he has been reappointed under President Johnson's Administration.

With his father, the late Louis Blaustein, he was co-founder of the American Oil Company (AMOCO). He is a Director of the Standard Oil Company (Indiana) and of a number of other business corporations, including the Union Trust Company of Maryland, and the United States Fidelity and Guaranty Company.

During World War II, Mr. Blaustein was acting Chairman of the Marketing Committee of the United States Petroleum Administration. He is a member of the National Petroleum Council of the United States Department of the Interior.

Mr. Blaustein is a member of the Presidium, and Senior Vice President, of the Conference on Material Claims Against Germany which negotiated the agreements with the Federal Republic of Germany for the rehabilitation of the surviving victims of Nazi persecution, and which is handling the distribution of proceeds.

He was National President, is now Honorary President, of the American Jewish Committee. In 1946, he was Chairman of the AJC Delegation at the Paris Peace Conference.

He is active in many philanthropic organizations; and is on the Boards of several educational and several scientific institutions, including the Maryland Academy of Sciences and the Baltimore Museum of Art. He is a member of the Board of Governors of the Hebrew University in Jerusalem, and is a member of Columbia University's Advisory Council, School of International Relations.

Mr. Blaustein was awarded honorary Doctorates of Humane Letters by his alma mater, Lehigh University, and by the Hebrew Union College; also honorary Doctorates of Laws by The Maryland Institute, College of Art; and an honorary Doctorate of Political Science by Wilberforce University.

Mr. Blaustein has received a number of other awards, such as the Award for Citizenship by The Albert Einstein College of Medicine; the Distinguished Service Award by the University of Maryland; the Richard Gottheil Medal by the Zeta Beta Tau Fraternity; the American Liberties Medallion; and the Achievement Award from the Society for Advancement of Management.

Mr. Blaustein was appointed by the King of Sweden to the Board of Trustees of the Dag Hammarskjold International Foundation; and is a Trustee of the Eleanor Roosevelt Memorial Foundation; a Trustee of the Lafayette Fellowship Foundation; and a Director of the Adlai Stevenson Institute of International Affairs.

JAMES A. CRUTCHFIELD

Dr. Crutchfield is presently Professor of Economics at the University of Washington, with which he has been associated since 1949. Dr. Crutchfield is well known in the field of fishery economics and water resources and has participated in several national and international conferences on these and other subjects. He has also been the recipient of numerous research grants to study various aspects of the fishing industry.

In addition to his academic duties, Dr. Crutchfield has held several advisory positions. Among these are the positions of: Chief of Mission, Food and Agriculture Organization of the United Nations, Nigeria; Member of the Advisory Committee on Fisheries Research of the National Academy of Sciences; Chief of Mission of the UN Special Fund Mission to Ghana; and many others.

Born on September 9, 1918, in New London, Connecticut, Dr. Crutchfield received his BA degree in 1940 and his MA degree in 1954 from the University of California. He is the author of numerous professional articles and publications.

FRANK C. DI LUZIO

Mr. Di Luzio has been Assistant Secretary of the Interior for Water Pollution Control since July 1966. Previous to his appointment as Assistant Secretary he was Director of the Office of Saline Water in the Department of the Interior. His first government position was as engineer with the Bureau of Reclamation on the Grand Coulee Dam Project in 1939. In 1944 he was assigned to the Manhattan Engineering District US Army Corps of Engineers, and from 1944–1957 he held various positions with the Atomic Energy Commission. From 1957–1961 he was Deputy Manager of the Atomic Energy Commission's Operations Office in Albuquerque, New Mexico, from which position he moved to various executive offices with Fairbanks, Morse and Co., serving as General Manager of the firm's Albuquerque Research Center, Vice-President of Engineering for the Beloit Division, and Vice-President and Director of the Hydraulic and Special Products Division. From 1963–1965 he served as staff director of the US Senate Committee on Aeronautical and Space Sciences.

Mr. Di Luzio, a United States citizen, was born in Rome, Italy, on September 2, 1913, He studied civil engineering at the Cleveland Institute of Technology and the Case Institute of Technology and received his BS from Fenn College in 1938. In 1957 he attended the Harvard Graduate School of Business Administration.

LEON JAWORSKI

Mr. Jaworski is presently senior partner with the law firm of Fulbright, Crooker, Freeman, Bates and Jaworski with whom he has been associated since 1931. He is also Director and Chairman of the executive committee of the Bank of the Southwest, Houston, Texas; a Director of Anderson, Clayton and Company; a Director of Gulf Publishing and Gulf Printing Company; a Director of Benjamin Franklin Savings Association; and a Director of the Pan American Sulphur Company.

Mr. Jaworski has held many positions in the public service. From 1962–1965, he was Special Assistant to the US Attorney General and from 1963–1965, he was Special Counsel to the Attorney General of Texas. He is a member of the National Citizens Committee for Community Relations, a member of the President's Commission on Law Enforcement and the Administration of Justice, Chairman of the Governor's Committee on Public School Education, a past Chairman of the Houston-Harris County Economic Opportunity Organization, and a U.S. member of the Permanent Court of Arbitration, The Hague. He was named recently by President Johnson to serve as arbitrator of the International Center for Settlement of Investment Disputes.

Mr. Jaworski is a member of numerous professional associations and is a past President of the State Bar of Texas, The American College of Trial Lawyers, the Houston Bar Association, and the Texas Civil Judicial Council. He is the author of several professional articles and a book, "After Fifteen Years," a behind-the-scenes account of the Nazi war crimes trials.

Born in Waco, Texas, on September 19, 1905, Mr. Jaworski received his Bachelor of Laws degree from Baylor University in 1925 and his Master of Laws degree from George Washington University in 1926. He is a member of several civic and charitable organizations and has received numerous civic awards.

JOHN A. KNAUSS

Dr. Knauss is presently Professor of Oceanography and Dean of the Graduate School of Oceanography at the University of Rhode Island, positions he has held since 1961. From 1951–1961, he was a staff member of the Scripps Institution of Oceanography, and from 1949–1951, he was an oceanographer in the Office of Naval Research.

Dr. Knauss is presently President of the Oceanographic Section of the American Geophysical Union. He is a member of the Committee on Mine Warfare of the National Academy of Sciences, National Research Council; Chairman of the panel on Oceanography of the Advisory Committee to the US Coast and Geodetic Survey of the National Academy of Sciences; a member of the panel on Oceanwide Surveys of the National Academy of Sciences Committee; and a member of advisory panels to the Atomic Energy Commission and the US Weather Bureau.

Born on September 1, 1925, in Detroit, Michigan, Dr. Knauss received his BS degree in 1953 from the Massachusetts Institute of Technology, his MA in 1949 from the Unliversity of Michigan, and his PhD from the Scripps Institution of Oceanography of the University of California in 1959.

JOHN H. PERRY, JR.

John H. Perry, Jr., is President and Chairman of Perry Publications, Inc., a Florida corporation which operates twenty-eight newspapers in Florida; ALL FLORIDA magazine, a Sunday supplement; PALM BEACH LIFE magazine, THE FREEPORT NEWS on Grand Bahama Island in the Bahamas; The Statewide All Florida News Service; and numerous commercial printing plants in Florida and Atlanta, Ga.

Mr. Perry pioneered in the use of computers for production of newspaper typesetting and ad composition. He also has developed the Perry Photo-Composer for automatic newspaper page makeup. He designed and developed the first four-color web wrap-around rotary press. Also, he invented and developed the Perry Cubmarine, a small manned submarine, and other underwater devices. Cubmarines are produced by Perry Submarine Builders, Inc., of which Mr. Perry is President.

He is a Director of the Inter-American Press Association; Cowles Communications, Inc.; the Carribbean Conservation Corporation; and is a National Associate of the Boys' Clubs of America.

He is a Trustee of the International Oceanographic Foundation and a member of the Ocean Sciences and Engineering Council of Palm Beach (Florida) County, Inc., as well as a member of the Advisory Council on Naval Affairs in the Sixth Naval District.

Mr. Perry was born in Seattle, Washington, on January 2, 1917; graduated from Hotchkiss in 1935; Yale in 1939; and attended the Harvard School of Business Administration. In World War II, he served as a pilot in the Anti-Submarine and Air Transport Command and is now a licensed commercial pilot. Mr. Perry is the author of a book entitled, "The National Dividend."

TAYLOR A. PRYOR

Mr. Pryor, a resident of Hawaii, is the founder of the Makapuu Oceanic Center where a marine exhibit, a marine science institute, and an ocean engineering testing facility are operated under his direction. President of The Oceanic Foundation, Mr. Pryor is also a Director of the National Oceanographic Association, Sea Life, Inc., C. Brewer Corporation, and the Hawaiian Manufacturers' Association. He served as a member of the Senate of the State of Hawaii from 1965 until his appointment to the Commission on Marine Science, Engineering and Resources in 1967. He serves on the Governor's Advisory Committee for Science and Technology and is a member of the Science Advisory Committee to the New England Aquarium.

Born in Connecticut in 1931, Mr. Pryor reecived his BA from Cornell and his graduate training in Marine Ecology from the University of Hawaii. He was a Naval aviator, USMCR, from 1954 to 1957. A receipient of the Honolulu Chamber of Commerce Progress Award of 1964 and the Hawaii J. C. TOYM Award of 1966, Mr. Pryor is the author of several publications on marine life and marine conservation.

GEORGE E. REEDY

Mr. Reedy is currently President of the Struthers Research and Development Corporation, Washington, D.C. He is also Vice-President for Planning and a Member of the Board of Directors of Struthers Wells Corporation. Prior to these positions Mr. Reedy had a long career in politics and government. He has served as Press Secretary and Special Assistant to President Johnson. Previously, he served as Staff Director of the Senate Democratic Policy Committee from 1953 until 1961. Prior to his association with the Policy Committee, Mr. Reedy was Staff Consultant to the Senate Armed Service Preparedness Subcommittee for two years. Except for the period from 1942 to 1946, Mr. Reedy was a congressional correspondent for United Press. During World War II, Mr. Reedy served in the mid-Pacific as a Captain in the USAF.

Mr. Reedy was born in East Chicago, Indiana, on August 5, 1917. He received a BA in Sociology from the University of Chicago in 1938.

GEORGE H. SULLIVAN

Dr. Sullivan is an executive of the Northrop Corporation, Beverly Hills, California. As director of Life Sciences for Northrop he has the responsibility for planning, organizing and implementing all the research and development programs in which man or other lower life forms are an important element. Many of these programs are directly related to the use of the oceans. Significant examples are: systems engineering support to the US Navy Man-in-the-Sea project, biomedical problems relating to survival of SCUBA swimmers, antibiotics from the ocean, and mass culture of marine algae for human consumption.

As an electrical engineer assigned to the Navy Department's Nuclear Reactor Electrical Control Branch between 1955 and 1957, Dr. Sullivan was responsible for the design, development and operation of the electrical, steam and reactor control systems for the first, and subsequent, nuclear submarines. Previously, he had served as a naval line officer, gaining extensive submarine experience aboard the USS WAHOO.

Dr. Sullivan graduated from the US Naval Academy in 1948 with a Bachelor of Science degree, and received his Doctor of Medicine degree from Georgetown University.

ROBERT M. WHITE

Dr. Robert M. White became the first Administrator of the Environmental Science Services Administration (ESSA) when the new Department of Commerce agency was established in July 1965.

Before his appointment as ESSA Administrator by President Johnson, Dr. White had been Chief of the Weather Bureau, US Department of Commerce, since October 1963. He has also served since early 1964 as Federal Coordinator for Meteorology, with the responsibility for coordinating and planning Federal weather services and supporting research.

Born in Boston in 1923, Dr. White received a BA degree in geology from Harvard University in 1944. While attending Harvard, he worked as a weather observer at the Blue Hill Observatory. During World War II, Dr. White was a Captain in the US Air Force with duties in both weather forecasting and instruction. Continuing his studies in meteorology at Massachusetts Institute of Technology, he earned his Master's degree in 1949 and his Doctorate in 1950.

From 1952 to 1958, Dr. White was Chief of the Large Scale Processes Branch of the Atmospheric Analysis Laboratory at the Geophisics Research Directorate, Air Force Cambridge Research Center. During this time, he directed a program of studies on the dynamics of general atmospheric circulation, long-range forecasting, and statistical weather prediction. In 1958, he became Chief of the Meteorological Development Laboratory at the Cambridge Research Center, providing technical leadership of an extensive research program in weather prediction, atmospheric dynamics, applied climatology, and meteorology and meteorological equipment. During the first half of 1959, he was a research associate at Massachusetts Institute of Technology, studying problems of stratospheric meteorology.

He joined the Travelers Insurance Companies at Hartford, Connecticut, in July 1959, as head of the Travelers Weather Research Center. Later, he was Associate Director of the Research Department of the Travelers Insurance Companies. When the Travelers Research Center, Inc., was established in 1960, Dr. White became its first President. He served in this position until his appointment by President Kennedy as Chief of the US Weather Bureau. Dr. White is a member of numerous professional and honorary societies.

Mr. Lennon. Dr. Stratton, we are delighted to have you and Dr. Geyer here today. We welcome you and we look forward with pleasure and anticipation to your statement and any colloquy that may come from interrogation from members of the committee.

STATEMENT OF DR. JULIUS A. STRATTON, CHAIRMAN OF THE COMMISSION ON MARINE SCIENCE, ENGINEERING, AND RESOURCES, ACCOMPANIED BY DR. RICHARD A. GEYER, VICE CHAIRMAN; AND DR. SAMUEL LAWRENCE, EXECUTIVE DIRECTOR

Dr. Stratton. Mr. Chairman, members of the committee, may I respond to the chairman's opening remarks by assuring you how very much I and the members of the Commission appreciate this opportunity to appear before you to report on what we are endeavoring to do, to indicate, rather informally at this time, the problems that we see looming ahead of us and what we are attempting to do about them, and also to have your advice and counsel.

I have prepared a formal statement. With your permission I am going to begin by reading that—it is not very long—since I think it will emphasize the background and the main points and be helpful to our discussion.

On January 9, 1967, the President of the United States, acting under provisions of the Marine Resources and Engineering Act of 1966 (Public Law 89–454), announced his appointment to the Commission on Marine Science, Engineering, and Resources. Over the intervening months the Commission has settled upon its objectives, planned its attack, chosen its staff, and is now hard at work. I am pleased to respond to your invitation to report to you today upon those plans and objectives and upon progress toward the completion of our task.

Your committee, Mr. Chairman, has been actively and effectively involved in all the steps that led to the establishment of the Commission as well as the National Council on Marine Resources and Engineering Development. For this reason there is no need for me to recall in any detail the background of the present legislation, other than to note that the act does set forth clearly at the outset a declaration of national policy and certain specific goals for the marine interests and activities of our country. Among these are:

1. The accelerated development of marine resources.
2. The expansion of knowledge relating to the marine environment.
3. The encouragement of private investment in marine enterprise.
4. The preservation of American leadership in marine science and technology.
5. The advancement of education and special training in all fields of science and engineering that bear upon the oceans.
6. The mobilization of the technical resources of the Nation, both public and private, for the more effective utilization of the oceans.
7. Cooperation with other nations and with international agencies in marine affairs insofar as such cooperation proves to be in the national interest, a very difficult problem indeed.

Under Public Law 89–454 the Commission is charged first with the task of examining the Nation's stake in the development, utilization, and preservation of our marine environment.

Second, the Commission is asked to review the state of all current activities in the broadest domain of marine science, as well as those contemplated for the future, and to assess their adequacy in meeting the specified goals set forth above.

Third, on the basis of these investigations, the Commission is requested to formulate a comprehensive, long-term, national program for the marine sciences designed to meet present and future national needs in the most effective possible manner.

And fourth, the Commission shall recommend a plan of governmental organization best adapted to the support of the program.

The Council and the Commission are complementary bodies, although in certain areas their interests inescapably overlap. The members of the Council represent at the highest level the major Federal departments and agencies concerned with marine affairs. The Council is directly concerned with current matters. It bears the responsibility of coordinating marine programs and of advising and assisting the President on a continuous basis. However, since it is also charged with the shaping and strengthening of Federal programs for the oncoming budgetary years, it must also initiate new activities and engage in extensive surveys and forward looking studies. That is an area, of course, where we come together.

By contrast, the Commission is wholly free of operating responsibilities. Our members represent diverse interests and areas of the country. Three are drawn from the Federal Government, one is commissioner of fisheries in the State of North Carolina, and the remainder have associations with industry, with academic institutions and the professions, and with organizations engaged in marine science and technology.

May I interpolate here and say that some are deeply and continuously involved in marine affairs, and some such as myself, have had in the past other interests more tangential to the problems of the sea but perhaps even more directly related to the kind of issues with which this Commission is charged.

We are aided in our task by four Members of Congress, who serve as our advisers: your distinguished Chairman, the Honorable Alton A. Lennon; and also from your subcommittee the Honorable Charles A. Mosher; from the Senate, the Honorable Warren G. Magnuson and the Honorable Norris Cotton. We are fortunate in the support of a small but excellent staff, drawn as was the Commission from diverse fields and backgrounds. And to insure that we do not perpetuate ourselves, the enabling act prescribes that we shall cease to exist 30 days after the submission of our report.

In return for freedom from day-by-day involvement, we recognize that the Congress and the President await from the Commission a wholly detached assessment of the national effort in marine affairs, viewed from the standpoints of science, technology, economics, security, and the quality of our national life. Upon this basic evaluation of needs and resources, the Commission must endeavor to formulate a national plan for the future which will embody both vision and realism.

Within the span of your lifetime and mine there bave been many milestones along the path of progress. Technically among the most significant have been the development of nuclear energy and the penetration of outer space. Depending upon what we all are able to accomplish and set in motion, history may now well record with these the new exploitation of the seas.

Yet, I should like to emphasize that the circumstances underlying these forward thrusts differ profoundly from one to another.

In the field of atomic energy a brilliant, isolated discovery in the purest of sciences was converted with an unparalleled rapidity to practical purposes—both useful and destructive. The future of atomic energy, with all its stupendous implications, focuses upon the development of a single device—the nuclear reactor.

The triumph over outer space was the product of engineering breakthroughs within a relatively limited domain of technology involving propellants, materials, and electronics. Although the technological span of our space ventures is broader, it nonetheless is encompassed within a well-defined and totally novel array of hardware.

But the sea is an entirely different matter. From the beginning of time men have sailed upon it, have fished and swum in its waters, and searched along its shores. The ocean, sometimes hostile and sometimes generous in its moods, has always offered us its abundant resources in countless ways.

The level of marine technology has risen and expanded over the years. But the driving force and urgency of today's concern for the lakes and oceans comes from no one spectacular discovery or engineering achievement. It derives from the changing character of the world itself—from mounting economic needs, from a congested population, from the deteriorating countryside and shore, from a shrinking of earthly dimensions as transportation becomes ever more rapid. Suddenly—within a very short time—the import of all this has begun to bear in upon us. We are awakening to the enormous potential of the seas and are now responding to the challenge to exploit them for the greater benefit of mankind.

But how? How shall we plan the future? How shall we set the priorities? What should we hope to achieve and how shall we go about it? How, in sum, shall we mobilize and organize a truly national effort on a scale in keeping with the magnitude of the needs and opportunities?

Oceanology—as Senator Pell has very aptly named it, for it is a more accurate word than "oceanography"—is not simply a new frontier to explore. It has a history and structure that have come down from the past. It embodies a vast array of interests, of investments and technical activities on the part of industry. It engages the concern of universities, research institutes, and a multitude of agencies of government—Federal, State, and local.

As to how the Commission goes about its work, I point out first that it is now nearly 10 years since reports by the President's Science Advisory Committee and the National Academy of Sciences focused attention upon the vital import of our underdeveloped marine resources.

Over the intervening decade further reports, studies, and opinions have poured forth in profusion, many representing the experience, the careful thought, and the best judgment of the outstanding experts of the country. Federal agencies and private institutions have contributed. The U.S. Navy, the Interagency Committee on Oceanography, as well as the President's Science Advisory Committee and the National Academy of Sciences, have taken an active part. The Ocean Science and Technology Advisory Committee of the National Security Industrial Association, the Marine Technology Society, and the new National Academy of Engineering, among others, are actively engaged in significant studies; and since its establishment 1 year ago, the National Council has initiated through contracts a number of additional projects.

This was the state of affairs when the Commission began its work this past spring. We enter not into a fresh, untouched field, but one that has been rather thoroughly worked over. Our subject is enormously complex and marked by an extraordinary diversity of views and opinions. On one matter only is there complete unanimity: On the urgency of agreement upon a national plan of moving ahead.

As for the Commission, there is neither time nor need to redo the work of others. Together with the Council we shall initiate a few special investigations where gaps appear or ideas need confirmation. But our real task—and it is indeed an appallingly difficult one—is to draw upon this accumulating mass of information, to analyze, to reconcile, to consolidate, and finally from the current multitude of fragmented parts to create a plan and to propose an organization of effort for the future.

It will be clearly impossible for each individual member of the Commission to become familiar with every aspect of a field of such enormous breadth and complexity. Accordingly we have resolved ourselves into panels, each charged with a mastery in depth of some particular area. The rationale for any such breaking up into task forces is obviously arbitrary, and we have chosen to organize our inquiry under the seven following headings:

1. The level and quality of scientific effort—an examination of research, physical and biological, on the marine environment.

2. The level and allocation of national effort devoted to marine engineering and technology, with special attention to the respective roles of industry, and of the State and Federal Governments.

3. An inventory of marine resources—chemicals, minerals, and food—examined with a view to potential as well as present abundance and economic availability.

It is not enough to say that there are gold and magnesium and manganese modules. These have to be compared with the comparable resources on land, and we must take a hard look to see at what point and under what circumstances these will become available economically.

4. The extraordinarily complicated, emerging area of problems and knowledge which many consider to be the most important aspect of all—the combined environment of air, water, and land viewed as a system. I recognize that "system" is now the word of the day, but we are compelled nonetheless to look at these several parts, their interactions, and their behavior in combination and conjunction. This includes problems relating to the advancement of meteorology, the conservation of shorelines, and the pollution of estuaries.

5. The current level of private investment in marine exploration, technological development, and the utilization of resources, with particular concern for means to encourage private enterprise through investment incentives, legal measures, and technical assistance.

6. International aspects and problems relating to the future development of the total marine environment.

7. The current state and adequacy of education and training to meet the needs of marine science and technology.

Each panel is composed of from two to four members of the Commission with professional staff and consultant support. Hearings and conferences are being held throughout the country to afford ample opportunity for an expression of views on the marine sciences and their future needs. Several panels have in addition plans to send inquiries to selected individuals and organizations to solicit their informal opinions, and a program of interviews has been undertaken with outstanding scientists, engineers, economists, industrialists, educators, and legislators on one aspect or another of marine problems.

I might say personally that, in the end, the Commission has to make up its own mind and has to arrive at its own views on the basis of the evidence. This is not to be a Gallup poll. We do feel very strongly the importance of giving these various segments of our total society—public and private, academic and industrial—an opportunity to express their views.

The Commission has been meeting, as a whole, 2 days of each month. The results of panel activity are now beginning to flow in and to provide a basis of our broader discussion.

Our most difficult and pressing task at this juncture is to sharpen and reduce in number the key issues to be dealt with in our final report. At the moment there is a maze, a jungle, as you gentlemen well know, of issues, questions, positive and negative views, and possibilities. The range and variety of questions with which we must come to grips can be illustrated by the following abbreviated list:

1. What is the significance of the oceans to national interests? Should the United States undertake major new programs of research and development to meet economic, political, military, or scientific needs in the marine environment?

2. What can be done to enlist private capital and initiative more effectively in the development of marine resources? Do new technologies offer a basis for the development of new industries which will prove to be both competitive and self-sufficient?

3. Are the prospects of significant advances in environmental prediction and control sufficient to warrant at this stage a major invest-

ment in the research and observation necessary for the understanding of land, air, and sea as a coupled system?

4. What roles should be assumed by local, State, interstate, national, and international bodies in managing the use of offshore lands and waters?

5. What can be done to direct the development of ocean resources as a positive force for fruitful relations among nations, rather than a continuing source of friction and conflict?

6. What organizational changes and initiatives are necessary to achieve our objectives?

The Commission harbors no illusion that it can provide final answers to these or to a multitude of other related questions. Indeed, the legislation of 1966 as envisaged by the Congress was, I believe, only as a first step, albeit a tremendous one. But we have proceeded far enough to have confidence that over the coming months we shall succeed in outlining the salient features of a comprehensive plan for the more effective development of marine science and engineering, and I hope, gentlemen, in recommending how the utilization of our resources can best be managed.

Mr. Chairman, that concludes my formal statement. I might supplement it with a few very informal remarks.

I can say to you first that I believe the Commission has made a great deal of progress and that we are moving ahead on an enormous task.

A very important and fundamental part of that task is to come to understand a great array of issues, to see the problem as a whole, and to identify the connecting links between this aspect of governmental activity and its counterpart in industry. Indeed, searching for a comprehensive view of the whole is our charge.

We are asked in the legislation to present a national plan. I think we all must be clear in our minds about what we really mean by a national plan. The Commission is interpreting that in broad terms. This cannot be a master plan such as might be formulated by an authoritarian government. It must be a program or commitment, whatever word you wish to use, which involves not only the Federal agencies and the State agencies, but draws in and encourages our industrial and academic institutions. We need to set goals, to make clear what must be done and why. We must show what means there are to fulfill these goals.

We feel the Commisison has a special responsibility with respect to the private sector, more so by the nature of things than by direction of the legislation itself. This, too, represents an exceedingly difficult and elusive problem. How do you mobilize private interests and support them? There again, you see the great difference between the state of affairs in this broad array of marine activities as against a well-focused endeavor such as space or nuclear energy or computers.

Then there is the matter of recommending an organizational plan. We recognize that there are many ways in which that could be interpreted. We would not presume to come to you with a complete statement of how the Government is to be organized. We do hope we can come with a clear indication of the consequences of the present extremely fragmented state of marine affairs, the need for coordination and leadership, the relative merits of a concentration of authority and a decentralization of effort.

In conclusion, may I make one other very personal comment.

The problem we are facing is baffling and elusive because of its varied and diverse nature, because of its special background and history, as well as its potential and our own future needs. To mobilize our marine forces and resources is, as I have said, quite a different problem from other technical hurdles that we have faced. The issues here, speaking now from an organizational point of view, or what I would prefer to call a mobilization point of view, have a significance that goes beyond the oceans themselves, beyond the particular subject of marine science and resources. It seems to me that we are dealing with the fundamental character of contemporary society. In the past, more often than not, it was possible to divide interests and activities neatly into departments and agencies, whether in the public or private sector, but the great new problems of our time are not easily divisible. They overlap and fuse at the boundaries.

One may see this very clearly in our larger academic institutions. One can no longer confine the interests of the traditional disciplines in isolated departments.

To take an example, one of the most important fields to emerge in recent years is that of materials. It touches upon almost every aspect of science and engineering.

Or again, take the problem of the cities, one of the most desperate and important that faces us today. Whether approached from the academic, legislative, or administrative point of view, it brings together elements of science, economics, architecture, regional planning, and a whole variety of others. However you deal with this problem of the cities, it simply cannot be put into one compartment or another. So learning how to manage this kind of problem and give direction to its solution, is, I think, one of the major issues of the present and the future.

I will not pretend that I believe there is complete transferability from the solution of one such massive complex to another, but I would like to believe that if we attack successfully this great problem of the marine sciences, some of the views, some of the conclusions, some of the things we have learned may have a bearing beyond the confines of the sea.

Mr. Chairman, I thank you very much. I am at your disposal to answer whatever questions I can.

Mr. LENNON. Thank you very much, Dr. Stratton, for a very fine statement. From my association with the Commission, simply in a legislative advisory capacity representing the Congress, I know of your experience and your concern and your dedication to the position you have accepted and at which you are so admirably proceeding.

Dr. Geyer is the Vice Chairman of the Commission. I wonder if there is anything that you would like to add to what Dr. Stratton has said before the members are recognized for questions.

Dr. GEYER. Mr. Chairman, I appreciate the opportunity.

I would like to say I concur wholeheartedly in the statements of philosophy made in Dr. Stratton's prepared and oral statements. I might take this opportunity, however, for just a moment, perhaps to underscore one phase of the statements that were made in the report this morning, namely, the educational aspects.

Time is of the essence in the training of an oceanographer, and it cannot be interrupted for one reason or another if we are to accomplish the goals and aspirations that we are working on now in the Commission's report and activities. A ship can be built in a relatively short time, a few months or a year at most. Buildings can be built in the same span of time. But training cannot be hurried up. It takes years to train competent oceanographers.

In addition to that, we want not only high-level professional oceanographers necessary to accomplish the goals and aims we have, but we require backup in the form of technicians, and this requires training as well on different levels, in which at the moment there is a more serious gap.

What I am saying, briefly, is that we should not do anything in the interim period to slow down the potential number of trained personnel on all levels that will be required to accomplish our goal in oceanography.

At the present time my institution and other oceanographic institutions throughout the country are hampered in trying to handle the numbers of people who are interested in oceanography because of limitations of space and personnel and, to a certain extent, funds as well. This is a very small percentage of the total amount of money we are thinking of in the long-term goal as well as the short-term goal.

I am saying, in essence, because of the long time it takes to train competent oceanographers and because these will be necessary in ever-increasing numbers as time goes on, I hope we will be able to continue our efforts at an undiminished rate during this interim period.

Mr. LENNON. Thank you very much, Doctor.

I see in the audience another very distinguished member of the Presidential Commission, Dr. John H. Sullivan, of California, director of life sciences, Northrop Corp.

Doctor, we are delighted to have you, and would like you to stand so the people who do not know you might know you. Thank you so much, Doctor.

I have been requested and I ask unanimous consent of the committee to recognize a member of the committee out of order, in the sense only that it is customary to recognize left to right, because of an important engagement he has.

Mr. Pollock, of Alaska, since becoming a member of the Merchant Marine and Fisheries Committee, and especially of this subcommittee, has demonstrated an unusual amount of interest. He has attended a number of symposiums and forums on oceanography and oceanology and marine science forums around the country.

I wonder if the gentleman could assure me he would not take more than 5 minutes.

Mr. POLLOCK. Mr. Chairman, I certainly will not take more.

Mr. LENNON. I recognize the gentleman.

Mr. POLLOCK. I appreciate very much the time.

First, I would like to say to Dr. Stratton it is nice to see him again. I had the pleasure of being presented a master of science degree in industrial management at MIT in 1960 from the good doctor.

Mr. Chairman, both for our distinguished guests and for the committee, I am very much concerned about something. Next week at the United Nations General Assembly it is planned to introduce a resolution by which the General Assembly would proclaim U.N. jurisdiction over all the ocean beds beyond the continental shelf. The United States apparently is ready to commit itself to this position.

It would appear to me this is a very far-reaching decision which involves a whole body of international law. There has been no public debate and no hearings on this at all. It has come up rather suddenly. It would appear to me, Mr. Chairman, this committee has a very real responsibility now thrust upon it to see that this country not just blindly proceed in this direction without adequate consideration. I am very concerned about it.

I am not sure I know how we should proceed. Certainly I would like to have the comments of Dr. Stratton and his colleagues. I wonder if it would not be appropriate, even on an emergency basis, for this committee to consider the possibility of hearings in this regard. I think it is very far reaching, and certainly it concerns the jurisdiction of this committee.

Mr. Lennon. I am somewhat familiar with what the gentleman refers to. I will ask Dr. Stratton and Dr. Geyer if they would be willing to comment on that matter, or if you would rather not comment on it, I can certainly understand it.

Dr. Stratton. Is it appropriate for me to go off the record on this?

Mr. Lennon. Yes. Off the record.

(Off the record.)

Mr. Lennon. Gentlemen, we will return to the statements of Dr. Stratton and Dr. Geyer. I am happy to recognize our distinguished colleague, the ranking member on the subcommittee and a member of the Advisory Committee, Mr. Mosher.

Mr. Mosher. Thank you, Mr. Chairman.

Since I have to leave soon, also, I do want to raise a rather delicate question, the same question that Mr. Karth raised in the committee recently, concerning the timing of the Commission's report.

Dr. Stratton has given us a very eloquent definition of the nature, difficulties, and importance of the Commission's work, which only confirms the importance that this subcommittee attaches to the Commission's work. Because it is so important, I think we have to be concerned that the Commission's report have the maximum impact on the Congress and the public.

The Commission got a late start, that is, late in terms of what we thought of at the time we adopted the legislation. Unfortunately, as now scheduled, the deadline for the Commission's report will be at the tag end of this Congress. Really, this Congress will have become a lameduck Congress by then. It will be right in the middle of the presidential election. There conceivably would be what I think would be the horrible prospect that the report might become a factor in the election. I would hope it would not, but it might become a partisan factor in the election.

At any rate, the report is likely to come when the Nation and the Members of Congress would give the least possible attention to it. Therefore, I am very hopeful, and I know you are, Mr. Chairman, and I know others on this committee are hopeful, that the Congress may extend the deadline so the report will be made to the public and to the Congress just ahead of the convening of the 91st Congress or at the time it convenes, and therefore have a much greater impact.

For these very practical political reasons, I am hopeful that this committee will recommend to the Congress that the deadline for the report of the Commission be extended at least 6 months.

Mr. Downing. Why do you make that request?

Mr. MOSHER. For the reasons I have just outlined.

Mr. DOWNING. Political reasons?

Mr. MOSHER. Political in the broadest sense, public relations reasons, having this report come fresh to the new Congress rather than come in the waning days of the old Congress when we are all involved in campaigns and will have no chance to give it any attention. It will be an old, outdated report, I am afraid, when the 91st Congress convenes.

Moreover, even though the Commission may complete its studies on the original schedule, I think it has very serious practical problems, Mr. Downing, in terms of getting the proper amount of time to put the report together and to get it printed. It seems to me to be a very important matter.

Mr. DOWNING. I agree with the gentleman, but I feel it would be better to go ahead and release the report as quickly as we can in order to get reaction to it.

Mr. MOSHER. I think you will get a much more urgent start and a much better start and more effective start by postponing the release of the report.

Dr. Stratton, I am not really asking your opinion on this unless you want to venture it. I think this is a decision the Congress has to make, rather than the Commission itself. If the Commission would feel a little leeway would solve some of its practical problems in getting the report out, that would be one element that we should consider.

Dr. STRATTON. If the chairman will permit me to comment, I shall proceed to do so.

Mr. LENNON. Yes. Go ahead, Doctor.

Dr. STRATTON. This question of timing has been very much on my mind in recent weeks, was the subject of discussion in the Commission itself at our last meeting, and I propose to raise it again tomorrow.

I should like particularly to respond to Mr. Downing's question. As you indicated earlier, the Commission was established in January. But the mechanics in these busy days of organizing a Commission which draws heavily from a variety of nongovernmental institutions is much more complex, as you certainly understand, than in the case of the Council where since it calls chiefly upon existing agencies, the group is more or less immediately in being. The purely practical problems of gathering the Commission together, of finding qualified staff, and getting started took not longer than I anticipated, but longer than I would have wished. So it was naturally spring before we were really in motion.

As we begin to project our schedule, the tightness of the timing has become more and more apparent from the standpoint of doing the job we have been asked to do.

Let me say informally that all of us—I particularly—have been most reluctant even to consider the question of an extension. We had a mandate. We had a job to do with a deadline. We started out, as I stated in my initial remarks, to meet that deadline. We will still do so if that seems most advisable.

We recognize also that you can, of course, go on indefinitely with a study of this kind. It could be never ending. To a point, there is some justification for extra time allowing for added effort and a resulting increase in return, but there is a point also where the incremental value of additional time and effort begins to diminish.

As it seems to us at the moment—leaving out the factor of elections and timing which you have brought to our attention, but recognizing that we, too, desire that our recommendations be useful and effective—that the best plan would be to complete our work, as far as the first decisions and tentative conclusions are concerned, on schedule in June or July. But we do believe it would be wise to have a little time to test and weigh these decisions and conclusions in an orderly fashion.

We will make some very basic recommendations, and we would like to be sure that we have considered all the implications and have an opportunity to discuss them with you gentlemen and the agencies before making our own final judgments. Then, of course, there will be time needed for the final processing and printing.

So, I must say, Mr. Chairman, I have reluctantly come to the conclusion that we could give you a much better report and better results with an extension of about 6 months. But we will abide by your own decision on that matter.

Mr. Lennon. I would like to comment on that by saying that we must recall that the Commission was appointed on January 9 of this year. Under the legislative mandate they had 18 months, or until July 9, 1968, to file their report. As I understand, since the decision was made, and I think properly so, to divide the Commission into several panels to make studies in depth of the various facets of oceanography, oceanology, and marine sciences, and to have hearings throughout the country, I would assume in the next several months, perhaps into early spring, these panels will be engaged in this activity. Then they will have to report to the full Commission. Assuming these reports came in from the several panels to the Commission in, say, late February of next year, that would give the Commission only approximately 30 days, at the most 45 days, to assess the findings, conclusions, and recommendations and to make your final report.

Then you run into the question of the editing and the printing, which can vary from 6 weeks to 3 months.

On the other hand, if the statutory limitation of July 9, 1968, were extended, you could carry on your activity until approximately August or early September, but by early September of next year you would have had to have all of your reports in from your panels, assess them, evaluate them, and then you would be faced with 6 weeks to 3 months for editing and printing, which gives a target date, as I see it, of approximately December 9, or thereabouts, of next year.

It is Mr. Mosher's understanding and my understanding that we were selected only as advisers to the Commission by reason of the fact that Mr. Mosher and I happened to be the respective ranking members on the committee. I want to make it crystal clear if I did not think the Nation and the world would benefit by this extension of time, if I did not have the sincere conviction that the Commission was of the caliber that it is and that it is rendering the service that it is, I would be the first one to say stay within the legislative mandate deadline.

I think it might be well to comment, too, on the attitude of the National Council. You remember, Mr. Downing and others, how wide a variance of opinion we had with respect to whether there should be a Council. The executive branch of the Government was opposed to a Council. I had my trepidations about the Council, especially a permanent Council. You recall when we went to conference we provided through a change in the legislation that the Council, instead of phasing out 60 days after the Commission's expiration date, which was 30 days after they filed the report, would continue 120 days. We were persuaded, and I am certainly happy we were. I recall I made the compromise that was accepted by our counterparts in the Senate on the conference to 120 days.

I have been delighted with the caliber of work and interest and concern and time and dedication that the Council has demonstrated, led by the Vice President. I was furnished, at my request, by Dr. Ed Wenk, the Executive Secretary of the Council, a synopsis of the meetings of that Council since it came into being and individuals by title and name who attended each of these meetings. Before we finish today, I am going to ask unanimous consent to put that in the record.

I am advised that the Council is of the judgment that the legislation ought to be amended to extend the life of the Commission for a period of 6 months and to extend the life of the Council for a period of 6 months rather than 120 days after the Commission files its final report.

I say this because Mr. Mosher and I have been especially privileged to follow both the work of the Commission and the Council. The political connotation of it does not concern me except that I know if the Commission was forced to comply with the legislative statutory language and file its report by July 9 of next year that hopefully all of us in the Congress will be busily engaged in our own personal activities as I anticipate it.

I share the view of Mr. Mosher here, not for the political connotation but for the fact that I do not believe in the throes of a political campaign from July until the first or second Tuesday in November next year that the Commission report would get the attention of the interested scientists, science writers, scientific magazines and the periodicals as well as the general news media. I am so pleased, Mr. Downing, with the Council's activity I think we would be making a tragic mistake to phase them out of existence because they will hold together, and I anticipate it will take the Congress somewhere in the neighborhood of 6 months or better to analyze and digest the Commission report and to translate that report into meaningful legislation.

I have expressed myself in the past hopefully that the Commission report would meet the acclaim of the legislative branch of the Government, the executive branch of the Government, universities, and laboratories in the private sector. That is the status of the thing.

I happen to know that Dr. Stratton's goal was to meet this deadline, I happen to know it was the goal of a number of the members of the Commission to meet this deadline of July 9 of next year, but I think now there has become an awareness and a recognition on the part of both the Commission and on the Council, and when we speak of the Council we speak of the Vice President, the various Secretaries at the Cabinet level and other high officials in the Federal Government.

(Off the record.)

Mr. Lennon. Mr. Downing?

Mr. Downing. Mr. Chairman, this is such an enormously complex subject which you are undertaking that I doubt that you could ever say your study is complete, and if we gave you 5 years, a man as dedicated as you and your colleagues would still not be able to tell us this is the final word.

I would never be arbitrary about the extension of your time, and if you need it in your judgment, I would certainly support it. But my point is, Mr. Chairman, I do not think the submission of this report should be based on the political timing of the report.

Mr. Lennon. I thank the gentleman, and having the admiration and respect for him I do, I do not think he meant to say this report would become a political issue at the national level.

Hopefully this subcommittee and the full committee has over the years been bipartisan in all of its objectives. I think what he was referring to and what I alluded to was if the report came out after July 9 next year—I do not know what the situation in your section is but I do know what it is in mine. I have to get down there and tend to a certain sort of business. And in the throes of adjournment and with the publicity all aimed at the political aspects next year, I do not believe this report would get the proper imagery. It would be just too competitive. You cannot compete with politics, not even with the report of such a fine Presidential Commission as this.

I think that is what the gentleman referred to.

I will say one thing else: If we did not have the National Council doing the job that it is doing then I would be like you, I would insist on the Commission trying to meet its deadline, whatever loss the scientific world might suffer. But I happen to have such high faith—you remember, Mr. Downing, in the hearings on this particular legislation that we had furnished us a list of those people who attended the Inter-Agency Ad Hoc Committee on Oceanography, and I believe at the first few meetings they just did not attend.

I want to show you this morning the people who have attended every meeting of the Council since they came into being almost a year ago now. Last December I believe it was. It has surprised me, pleased me, and amazed me.

I know if we continue their life for 6 months, then by that time the Congress will have either resolved this question of the governmental agency to operate this whole thing or we will have thrown up our hands and quit.

I share your feeling about it. We have felt like this. In fact, I feel strongly. I know that is your conecrn. I say to you in absolute good faith I think we are making progress, I think we are making excellent progress. If I did not think so, I would be the first one to want to repeal the law and not even give them to July 9 next year to file the report.

Mr. Pelly. Mr. Chairman, may I say Dr. Stratton, as one who has had a part in the framing of the law and has been in conference with the Senate and has seen it worked out, that it is certainly gratifying to me to have you here today.

It has been long time coming. I intend personally to use this whole matter as a political issue in my district. My district is very much interested in this subject. Whether your report comes out or not, I am going to point with pride to our accomplishments.

I might add, too, that I do not think there will be full recognition of the importance of your report when it does come out, except by the scientific fraternity. This is the way I feel about it. I think this is a very important day, your being with us.

I wonder if you are aware, Dr. Stratton, that concerning land laws and planning a commission similar to yours is working on these problems. I had the pleasure of being invited to attend one of their hearings in my district during the Labor Day recess. It is tied up with problems arising out of the laws of 50 States. There are knots and this other commission is trying to untangle them. You have international problems which are not nearly as difficult in my estimation as those concerning the use of lands for recreation, wilderness areas, or national parks.

So while you may have difficulties, you still are in the infancy of resolving the international legal problems.

I just want to conclude by saying that we await the report when it does come. I will be glad to wait 6 months additional and support that if you feel you need the time. We are very anxious to get going and today, as I said, I think is a milestone to many of us who have waited for years to progress as far as we are now.

Thank you.

Dr. STRATTON. Thank you very much.

Mr. LENNON. Mr. Dow?

Mr. Dow. Dr. Stratton, I want to salute you for making a very splendid presentation. I like particularly the whole tenor of your statement as far as a broad overview of the whole problem of oceanography and, thankfully, you and your commission have not been lured into the depths of detail to a point where they have lost the broad picture. I think it good that you have been able to maintain your perspective.

I have only one question really and that is relating to page 12, your subparagraph:

> What organizational changes and initiatives are necessary to achieve our objectives?

I rather hope that your commission will make some recommendations so that our Nation will have an organization of a unified sort and a constant review in the future of these oceanographic problems, taking them as a whole, and that we will not lapse back into a fragmented situation that has obtained for a good many years in the past.

I would like to have your assurance that the commission would address itself to this concept of a continuing management.

Also, I would be curious to know, Dr. Stratton, whether any one of the task forces or subdivisions of the commission is working on the organizational problem or whether your whole commission at the end will address itself to that, taking all the parts into consideration before determining the general control for the future.

Dr. STRATTON. If I may respond, Mr. Chairman, Mr. Dow's surmise is exactly right.

In the first place, we have considered this problem of organizational changes and issues as really the central matter to which we must address ourselves. With respect to an organizational plan, we are by intent of the legislation in a quite different position than the council.

May I say here that I, too, share the admiration and respect for what the council has achieved, for the leadership and skill and energy of Dr. Wenk. It is incumbent upon the commission to insure through its recommendations that the vigor that has been infused into our marine sciences program through the council is preserved.

As I interpret the legislation, our major purpose is precisely that of bringing to bear our judgment on the problem of management and organization. And we will fail unless we give to you a proposed plan of organization which will carry on what the Council has demonstrated can be done, whether through that medium or some other.

Now, secondly, in laying out our panels we specifically omitted a panel on organization because we consider that to be the responsibility of the entire Commission. Each panel has been asked to consider not only the special technical aspects of its assigned area, but also relevant managerial or organizational factors. As we gather interim data from these panels, the Commission as a whole is now beginning to try to construct a plan of organization.

Mr. Dow. Dr. Stratton, that is very reassuring. I like your thinking along that line. I hope that will continue to guide your efforts.

Thank you, Dr. Stratton.

Dr. Stratton. Thank you, sir.

Mr. Lennon. Off the record.

(Off the record.)

Mr. Downing. Dr. Stratton, I want to compliment you and the members of the Commission and congratulate you on this report you have given us today. It is most enlightening and interesting and reassuring to us that some progress is actually being made. I have only two questions.

One is, is there any consideration being given by your Commission to the legal aspects of oceanography? Does that fall within your purview? It may not.

Dr. Stratton. Yes, it does, sir, and the chairman of our international panel is Professor Auerbach of the School of Law of the University of Minnesota. We are very much concerned with the legal aspects. They emerge from a variety of directions, as you recognize, not only at the international level but also with respect to the encouragement of private investment. I presume this is the sort of problem that you have in mind.

Mr. Downing. Yes, and then, too, the international aspects.

Dr. Stratton. The international panel is directly concerned with the legal matters.

As I say, Professor Auerbach is himself in the field of international law. Mr. Jaworski of Texas is also a lawyer, and he, too, is involved in the consideration of these problems.

Mr. Downing. Thank you very much, Doctor.

Mr. Reinecke. I would like to congratulate you also along with your committee. You have done a wonderful job. The completeness of your report seems to inspire more speeches than questions here this morning. Something that has been touched on before and I think needs to be touched on more is the question of jurisdiction between the Council and the Commission. I know you are being romanced by the Council and I think in some respects some of your findings or at least jurisdiction is being usurped by the Council.

I would be interested in knowing, recognizing this is a delicate question for you, whether or not you feel you do have a complete degree of freedom of action and that your recommendations are being kept as Commission recommendations or whether you feel some of these ideas are being picked up along the way and are being endorsed into reports such as the one introduced in March by the Council.

Dr. Stratton. You are asking me a difficult question in the presence of these gentlemen here.

Mr. Reinecke. I understand.

Dr. Stratton. I would like to be completely candid.

I began this task by reading the legislation very, very carefully a number of times. I must confess that as a newcomer to this area, I was rather puzzled in endeavoring to explain and interpret these overlaps in the respective charges to the Council and the Commission. As you know, there are tasks assigned to the two bodies. Sometimes they are to review, sometimes they are to survey, sometimes they must embark upon projects, and sometimes they are to make studies—the distinctions at times eluded me.

I have been enormously reassured, Mr. Reinecke, now that our operations are underway, in working with the Council. That is due to the statesmanship and clear-cut statements of the Vice President. His remarks to the Commission at its first meeting, and I have extracts from them here, spoke directly to this matter. He is well aware of the difficulties. He has himself pointed out that these are complementary bodies, and you know that in my own remarks, I have stated that by the very plan and nature of our assignment, there is inescapably an overlap. I repeat it today. There are overlaps. If we were to be continuing bodies, there would inevitably be very serious problems of jurisdiction. But we are not continuing bodies—certainly not the Commission.

The Commission has no vested interest. We have a job to do. We are determined—and I have no fear whatsoever that we won't succeed—we are determined to make an independent report. We are going to express our best views as to what should be done and how effective it will be, including the future of the Council itself. I have already expressed to you a moment ago my admiration for what they are doing. Whether this is the best way to do it in the future is a totally different issue.

I recognize the word is passed through the Council to the President, but I have the assurance of the Vice President that while they may comment on them, there will be no change.

When you come to the matter of whether some of the findings we are developing may be used by the Council, they can also ask the same question of us. I simply have to fall back on good faith, determined that we shall see this thing through, believing that we are going to get along together.

Mr. Reinecke. As one of the authors of the original Commission idea, I can state the reason we came up with the Commission was simply because we felt, due to the existing programs in the various agencies, that the Council could not in itself be sufficiently objective. So we are looking to you for a completely independent, totally objective report not based on assumptions that anyone else would do anything, and I certainly hope this will be the nature of your report, that you will not be swayed at all by any promises or anything from any of the Council.

I have the highest regard for the job of coordination the Council is doing. Nonetheless, we are here trying to establish some long-range legislation and policy and I know you gentlemen have accepted your responsibility very, very deeply in this regard and we are certainly looking forward to that objective report.

Dr. Stratton. I can reassure you completely on this score. There is not the slightest disposition on my part or any one of the Commission to present anything but an independent view of what is best, and we do not proposed to do this in a militant, aggressive or competitive way. This is our job.

Mr. LENNON. Mr. Roth?

Mr. ROTH. Mr. Chairman, I think perhaps my question can be best directed to Dr. Geyer.

You raised the point about the needs of an increased flow of oceanographers and technicians. As a newcomer in this area, I would be interested in knowing whether or not present facilities are adequate from a university standpoint, whether or not you have any estimates as to what are the needs in these areas.

Dr. GEYER. Mr. Roth, at the present time if we use the criterion of the number of people who are applying for graduate work in oceanography, and oceanography is a graduate curriculum per se, in our institution, for example, we had almost 200 applications for this coming academic year that just started, and because of our limitation of staff and space and funding and ship time and so on, we are only able to accept 20, and I hope we graduate 15. The same situation exists in about the same percentage in most of the other institutions. This is why I am concerned.

Knowing what our goals are and knowing what we want to do in regard to the long-range plans for marine scientists, this cannot be achieved unless we have this pipeline filled with competently trained people ready and available to take on the business that will be necessary in order to achieve the objectives.

This percentage I just gave you now of people who are interested—and these are qualified people too—in going into oceanography, the limited number we are able to take is something that concerns me very much. The same thing applies to the scholarship and fellowship relationships in oceanography. At the present time we have 68 graduate students. About half of those are funded by the university, which has about 20 fellowships and scholarships and the rest are from various Government agencies who are directed toward that work. But the percentage of the number of supporting fellowships and scholarships we get from the Federal group is decreasing all the time.

You may say well, if a person is really dedicated and interested in oceanography, he can do as best he can. But we are in competition with other disciplines as well where the funds are available in a greater amount, and naturally a very competent person has the ability at this point to look over the field of various disciplines and decide where he can make the best future for himself. This is, of course, one criterion we use as to what the support is in terms of funds for any one particular field.

Mr. ROTH. Are there, Dr. Geyer, any estimates of the actual numbers of oceanographers needed, say, for each year for the next 5 to 10 years?

Dr. GEYER. I believe that is being prepared by the National Science Foundation for this very purpose.

On the other hand, I have been involved in this situation through the Coordinating Board of Higher Education in the State of Texas. Last January they asked us for a 20-year plan in oceanography because they are concerned to make sure they can meet the commitments academically, and in the course of preparing this 20-year plan—fortunately it was early in January before questionnaires were getting quite as prevalent as they are—I sent out my own questionnaire to about 50 Government agencies and industries and companies in the country I know were actively engaged in oceanography, or planning to get into it.

As a result of this, I received about 30 replies, which is a pretty good percentage in this day and age because of the questionnaire flood. And just roughly summarizing the work, I asked what they would need in 5-year increments in the way of oceanographers, and the total over 20 years came to about 3,000 oceanographers.

A part of the questionnaire broke down to what major branch of oceanography the greatest interest was in. This turned out to be physical oceanography and engineering oceanography with geology, geophysics and chemistry, in that ratio.

This, of course, is not a true, I suppose, significant statistical sample of the nationwide need for oceanographers, but using this as a springboard and taking the 2,800 or 3,000 people they thought they would need during the next 20 years, you may multiply it by a factor of 50 percent or whatever factor you want and get at least some order of magnitude of the demand. But even these are professional oceanographers, and this is what I referred to before.

In order to really get the most out of a professional oceanographer, as any other scientist, he needs backup in the way of technicians, and we are even more woefully behind in technician training to back up these oceanographers.

So if you take the figure of 3,000 to 4,000 oceanographers during this period and a ratio of 3 to 1 technicians, you are talking about another 9,000 or 12,000 technicians that have to be trained.

I am not saying these figures are gospel or very accurate, but at least they give you an order of magnitude in reply to your question based on this one questionnaire.

I will be interested to see what the results of these other studies bring out.

Mr. Roth. One final question with respect to the technicians.

What type of training must they have?

Dr. Geyer. This is just my personal opinion. I think what we would need in the way of technicians to back up the professional oceanographers are preferably some people with training anywhere from 2 to 4 years beyond high school, and preferably 4 years, if not 2 years. This cuts across the whole spectrum of oceanographic endeavor from fisheries to pollution to engineering activities, and so on.

Mr. Roth. Thank you, Doctor.

Mr. Lennon. Thank you, Mr. Roth.

Mr. Keith?

Mr. Keith. Thank you Mr. Chairman. For some time, I have been concerned with an imbalance in the development and protection of our oceans' various resources. The Outer Continental Shelf Lands Act of 1953 gives the Secretary of Interior the responsibility of conserving and developing all the resources of the Continental Shelf—living resources as well as oil, gas, and minerals. I feel, however, that exploitation of minerals in the ocean's floor has often been promoted at the expense of the other values of the marine environment.

Permission to conduct exploration for underwater oil deposits, for example, has long been under the sole jurisdiction of the Geological Survey office—a bureau of the Interior Department, whose interest focuses on mineral development. Until the Bureau of Commercial Fisheries was allowed to get into the act of approving such licenses, there was no machinery to insure the protection of living resources which might be affected.

My question, Mr. Stratton, is: Does your Commission intend to give greater emphasis to the development of our tremendously valuable fishing resources, and do you expect to see a greater Government-wide concern for improving and modernizing our means of exploiting the oceans' food potential?

Dr. STRATTON. Let me assure you that the Commission is well aware of the serious problems relating to conflicting uses of the Continental Shelf, and of the need for improving and modernizing our means of exploiting the oceans' food potential. The Commission's panel on marine resources is chaired by Dr. James Crutchfield of the University of Washington who is an internationally recognized authority in the field of fisheries economics, and who is vitally concerned with problems of effective utilization of the living resources of the sea. Another panel, headed by Prof. Carl Auerbach of the University of Minnesota, is formulating plans for the study of jurisdiction and use of the Outer Continental Shelf, with particular reference to the accommodation of conflicts among different types of users. Clearly, we must avoid unnecessary destruction of fisheries resources as a result of actions taken by oil prospectors and other users. Not only is this an immediate problem of conflict, but it appears likely that recurring use conflicts will continue to arise and that some permanent governmental mechanism may be needed for their resolution. The Commission is giving close attention to this matter.

Mr. KEITH. In July, I filed a "Marine Sanctuaries Study Act" on behalf of myself and 13 other Members of the Congress. The philosophy behind this measure is that, before oil and mineral exploitation begins in new areas of our ocean frontier, a thorough study should determine the likely impact of such activities on the other natural resources of the marine environment.

My feeling is that some kind of "ocean zoning" may be necessary to make these various uses of the sea compatible with each other, and to prevent the destruction of the conservation, recreational, fishing, scientific, and scenic values of our coastal oceans. For this reason, my bill authorized the Secretary of Interior to study the possibility of setting up "marine sanctuaries" as areas whose natural values warrant their being excluded from industrial or mining development.

Mr. Stratton, would you comment on the approach in this bill, and tell me whether you think this concept should be implemented as legislation?

Dr. STRATTON. On August 23, our Commission's Executive Director wrote to the Honorable Edward A. Garmatz, chairman of the Committee on Merchant Marine and Fisheries, to express the Commission's views regarding the bill, H.R. 11584. which Mr. Keith had introduced. A copy of this letter is attached for your information. I would add that since this letter was prepared the Commission has begun some discussion of the feasibility of marine zoning. While I am not in a position to speak for the Commission as a whole, I would say personally that establishment of "marine sanctuaries" appears to be consistent with the preliminary thinking of several of the Commissioners.

(The letter mentioned follows:)

EXECUTIVE OFFICE OF THE PRESIDENT,
COMMISSION ON MARINE SCIENCE, ENGINEERING AND RESOURCES,
Washington D.C., August 23, 1967.

HON. EDWARD A. GARMATZ,
Chairman, Committee on Merchant Marine and Fisheries, House of Representatives, Washington, D.C.

DEAR MR. CHAIRMAN: This is in response to your request of July 25, 1967, for the views of this Commission with respect to H.R. 11584, a bill to authorize the Secretary of the Interior to study the most feasible and desirable means of establishing certain portions of the tidelands, Outer Continental Shelf, seaward areas, and Great Lakes of the United States as marine sanctuaries and for other purposes.

The desirability of establishing marine sanctuaries is a matter which will most probably be considered by the Commission on Marine Science, Engineering and Resources, in connection with its responsibility for developing a plan for "an adequate national marine science program which will meet present and future needs." However, the Commission is unlikely to investigate in detail the most feasible and desirable means for establishing these sanctuaries and has, at this time, no views regarding the need for a moratorium on development of those portions of the continental shelf under study as a possible marine sanctuary.

The Bureau of the Budget advises that there is no objection to the submission of this report from the standpoint of the Administration program.

Sincerely yours,

SAMUEL A. LAWRENCE,
Executive Director.

Mr. KEITH. We have heard that President Johnson has tentatively agreed to a scheme to turn over ownership and control of the entire ocean floor of the earth to the United Nations. Presumably, the development of new technologies to exploit the oceans' riches and the development of new uses of the sea would rest in the hands of some U.N. agency.

In my view, this is a very sweeping decision which would preclude the logical development of customary law relating to the oceans. It could also preclude the healthy national competition which gives the thrust to imaginative ways of reaping the harvest of the oceans' riches. This scheme is as grandiose as the papal edict in 1500 which divided the entire New World between Spain and Portugal—and it could be just as shortsighted and unrealistic.

Dr. Stratton, as an ocean scientist and an official charged with the responsibility for developing a national marine science program for the United States, do you feel that the approach we have heard about is the proper one for our Nation?

Dr. STRATTON. This is a matter which was discussed extensively at the September 14 hearing and on which I understand Dr. Wenk, executive secretary of the National Council on Marine Resources and Engineering Development, has commented further to your committee. From Dr. Wenk's comments, I think it is clear that the administration believes that it is premature to consider the types of arrangements contemplated in a treaty such as proposed by Malta, and that the entire problem is one which requires much more careful study and consideration than has been possible to date. This is a view with which I heartily concur.

Mr. KEITH. Thank you, Dr. Stratton.

No further questions, Mr. Chairman.

Mr. LENNON. Thank you, Mr. Keith.

Gentlemen, on August 17 Dr. Edward Wenk, the executive secretary of the National Council of Marine Resources and Engineering Development, appeared before the committee, and at that time I asked him to supply for the record the attendance of the Council's meetings by individual and title since their creation on August 17 of last year. I have just received this and I would like to ask unanimous consent that it be inserted in the record following his statement, and the attendance at each of the subsequent monthly meetings since that time of the National Council. I think it is indicative of the high caliber of the very top level of people who participate.

I would not take the time to read it, but it is very interesting and shows a continuing interest of people at the Cabinet level and their technical advisers who also attended with them. It has very much pleased me. Thank you very much.

(The material referred to may be found on p. 14.)

Mr. Lennon. Now the counsel will announce at this time the plans for the continuation of the hearings by this subcommittee for the record and for any help it might be to the members.

Mr. Drewry. Mr. Chairman, in your opening statement at the beginning of these hearings in August, you called attention to the fact that it is our plan to proceed not only with the Council and the Commission, but to receive testimony from the individual agencies of Government involved, and later on, if time permits, hopefully to receive industry testimony and other testimony from the private and public sector.

Next week we have hearings scheduled from Tuesday through Friday. On Tuesday, the 19th, the principal witness will be Rear Adm. Odale Waters, the Oceanographer of the Navy, and we assume his testimony will take the full morning session.

Wednesday the Atomic Energy Commission will appear with Mr. Arnold Joseph as principal witness.

The Coast Guard will follow the AEC with the commandant, Adm. Willard J. Smith.

On Thursday, the 21st, Dr. Stanley Cain, Assistant Secretary of the Interior, will appear followed by the Smithsonian Institution with either Dr. Dillon Ripley, the Director, or Dr. Sidney R. Galler the principal witness.

And Friday, the 22d, Dr. Robert M. White, the Administrator of the Environmental Science Services Administration, to be followed by Mr. Robert Abe, Director of the Sea Grant College program.

Other witnesses who we could not fit in last week for one reason or another include the State Department, Dr. Robert Frosch, Assistant Secretary for R. & D. of the Navy, AID, and the International Science Foundation, who will be scheduled at later dates.

Thank you, Mr. Chairman.

Mr. Lennon. Thank you, Mr. Counsel, and Dr. Stratton and the other members of the Commission. We understand you are here in Washington usually one weekend out of the month for your hearings and deliberations. We would like for you to know, sir, at any time the Commission desires, we extend to you or any member of the Commission the invitation for an appearance on any particular matter you feel like we ought to be advised of. If you will have your fine assistant, Dr. Lawrence, simply call Mr. Drewry, arrangements will be made accordingly. We will work it into our schedule.

The hearings will now adjourn until next Tuesday morning at 10 o'clock.

Thank you so much for your attendance.

(Whereupon, the hearing adjourned at 12:05 p.m., to reconvene Tuesday, September 19, 1967, at 10 a.m.)

NATIONAL MARINE SCIENCES PROGRAM

TUESDAY, SEPTEMBER 19, 1967

House of Representatives,
Subcommittee on Oceanography of the
Committee on Merchant Marine and Fisheries,
Washington, D.C.

The subcommittee met, pursuant to recess, at 10 a.m., in room 1334, Longworth House Office Building, Hon. Alton Lennon, chairman of the subcommittee, presiding.

Mr. Lennon. The meeting will please come to order.

This morning we are privileged to hear from Rear Adm. Odale D. Waters, Oceanographer of the Navy, who will present testimony concerning the Navy's activities in oceanography and marine sciences. I think we all have a right to anticipate that Admiral Waters' testimony will be among the most important which we have received.

The Nation's oceanographic activities are many and varied and, from the dollar standpoint or budgetwise, comprise about 60 percent of the total program.

During the testimony of both Dr. Wenk who, as all of you know, is the Executive Secretary of the National Council on Marine Resources and Engineering Development, and Dr. Stratton, who is the Chairman of the Presidential Commission, questions were raised concerning the so-called Malta proposal, that is, the request by the Government of Malta for the inclusion of a supplementary item in the agenda of the 22d session of the United Nations concerning "The reservation exclusively for peaceful purposes of the seabed and of the ocean floor underlying the seas beyond the limitation of present national jurisdiction and the use of their resources in the interests of mankind."

In view of the fact that the Marine Resources and Engineering Development Act of 1966 called for a comprehensive study of the problems arising out of the management, use, development, and control of the marine environment, members of this committee have felt and expressed great concern over the Maltese proposal. They feel that it is unwise and, at this time at least, premature for serious consideration to be given to this sort of proposal, at a time when the nature and the magnitude of the problems of the deep oceans are only beginning to be studied, much less understood.

In view of the convening of the 22d session of the General Assembly of the United Nations today, I felt it important that the subcommittee be advised promptly of the background of this situation and the U.S. position in regard thereto.

Accordingly, I have asked Admiral Waters' indulgence that we may go into executive session at 11:15 when we will hear from Dr. Edward

Wenk, Executive Secretary of the National Council on Marine Resources and Engineering Development, and, of course, officials of the Department of State.

Despite the necessary limitations on the time available to Admiral Waters, I hope we will be able to receive his general statement and all members will have an opportunity to question him, although perhaps not at the length that some of us might like to.

I might add if that develops, I am sure that Admiral Waters will find a way to cooperate with us at some future date to continue the consideration of his statement and the testimony he may give.

I wrote Dr. Wenk a letter on September 15 as a result of his testimony here on August 17. He has responded to this letter. In the interest of time, I will not read it until we move into executive session. If we have time, Admiral, I will put it in the record immediately following your statement.

If you will proceed, please, sir.

STATEMENT OF REAR ADM. ODALE D. WATERS, JR., OCEANOGRAPHER OF THE NAVY; ACCOMPANIED BY CAPT. J. E. SNYDER, U.S. NAVY, SPECIAL ASSISTANT TO THE ASSISTANT SECRETARY OF THE NAVY FOR RESEARCH AND DEVELOPMENT, AND CAPT. T. K. TREADWELL, U.S. NAVY, SPECIAL ASSISTANT TO THE OCEANOGRAPHER OF THE NAVY

Admiral WATERS. Thank you, Mr. Chairman.

Mr. Chairman and members of the House Merchant Marine and Fisheries Committee, this is my first opportunity to appear before you and discuss the Navy's contribution to the national marine science program, an opportunity which I appreciate very much. I have followed your activities with great interest in the past, for the role you have played in developing that national program is impressive. This series of hearings is further focusing attention on the area's many complex problems, and will be of service to all concerned.

In an age in which the impact of science and technology daily assumes greater importance, few areas of scientific and technological endeavor so stimulate man's imagination, whet scientists' curiosity, or hold such promise for all mankind as does oceanography. Almost every discovery in the realm of ocean science and technology has a useful application, and may directly and significantly affect our Nation's political, economic, and military posture.

Recent studies by groups under the President's Science Advisory Committee and the National Academy of Sciences have confirmed the need, long recognized by the members of this committee, for better understanding and utilization of the seas that surround us. Your Marine Resources and Engineering Development Act of 1966 (Public Law 89-454), which established a Cabinet-level Council and a major Commission to advise and assist the President in implementing national marine science policy, was a milestone in the national policy for exploiting the oceans. As you heard from Dr. Wenk, the Council is now deeply involved in its investigation of the enormous problems associated with the development of a truly effective national program. The Navy has given strong support to the development of the program from the outset, and will continue to cooperate with other Government bodies in support of the national goals representing the congressional will expressed in Public Law 89–454.

We are particularly looking forward to the report of the Commission on Marine Science, Engineering and Resources, discussed with you by Dr. Stratton, which will set forth guidelines for the most effective future organization to carry on their recommended long-term national oceanographic program. Our interest in the Council and Commission is reflected by the participation and interest of the Navy members, who represent the Department of Defense. Membership on the Commission includes the Under Secretary of the Navy, while the Secretary of the Navy is the Department of Defense representative on the Council. In addition, Dr. Robert A. Frosch, Assistant Secretary of the Navy for Research and Development, is Chairman of the newly constituted Committee on Marine Research, Education, and Facilities, which reports directly to the National Council. There is also continued active personal participation by Navy representatives in the several other policy and working groups associated with these organizations.

Within the Navy, the oceanography program, which is an integral part of the national effort, encompasses that body of science, technology, engineering, and operations, and the personnel and facilities associated with each, which is essential primarily to explore, and to lay the basis for exploitation of, the ocean and its boundaries for defense applications to enhance security and support other national objectives. Because of our daily use of the ocean, our interest is broad and immediate. The urgent need for worldwide knowledge of the operating environment of its forces, and the wide variety of operations affected by one or another facet of that environment, impel the Navy to support studies in every major oceanic area. Marine engineering and technological development and theoretical and laboratory studies complement these field investigations and are equally comprehensive. The Navy's demonstrated ability to put man within the hostile ocean environment for prolonged periods, to develop a variety of unique deep-research vehicles, floating instrument platforms, oceanographic towers, and scientific aircraft for useful work in, on, and immediately above the oceans, and to engineer data-collection systems, will one day make the worldwide collection of oceanographic data comparable with that for atmospheric data. A sound beginning has been made—our program for fiscal year 1968 thrusts us forward.

We have reached our current capability through the development of a good working partnership with the industrial and academic communities, and of course we work also in continual cooperation with other Federal and State agencies both through and outside of the established formal structures. For example, the Office of Naval Research and the National Science Foundation maintain an excellent working relationship in the support of oceanographic research at academic institutions; scientists from universities and other Federal agencies are continuing to play an important role in the Navy's man-in-the-sea program, and are an integral part of the next seafloor experiment, Sealab III; and the Coast Guard's new large navigational sea buoy to replace lightships is in large part an outgrowth of a Navy development. We feel that the Navy has attained a position of leadership among Federal agencies in certain areas of the marine sciences. This is a leadership which we hope we have earned through demonstrated capabilities and cooperative efforts, and it is a responsibility we do not take lightly. We plan to further strengthen the partnership with other Federal and State agencies, industry—both defense and nondefense—and the academic community.

The basic oceanographic policy of the U.S. Navy is to provide the capability for the Department of Defense to fulfill its assigned mission of maintaining the security of the Nation. The prime objective, then, is to increase the effectiveness of our operations. In fulfilling this objective, we carry out our diverse oceanographic efforts through industry, Navy laboratories, universities, nonprofit institutions, and other performers.

In recognition of the magnitude and importance of the naval oceanographic program and to assure program integration, the Secretary of the Navy last fall established my Office, the Office of the Oceanographer of the Navy, directly under the Chief of Naval Operations. I act as the Naval Oceanographic Program Director for the Chief of Naval Operations, under the policy direction of the Secretary of the Navy, through the Assistant Secretary of the Navy for Research and Development. The new organization was designed in the interest of centralized authority, direction, and control, including control of resources, to insure an integrated and effective naval oceanographic program. To further these objectives, the Chief of Naval Research has been assigned additional responsibility as my Assistant Oceanographer of the Navy for Ocean Science, and the Deputy Chief of Naval Operations for Development has been assigned additional responsibility as my Assistant Oceanographer of the Navy for Ocean Engineering and Development. The organizational structure includes an Assistant for Oceanographic Operations whose appointment is pending.

The Assistant Oceanographer for Ocean Science is responsible for a broad scientific and technical program through support of academic and institutional scientists and engineers throughout the country and within Navy laboratories. This program provides the broad base of knowledge about the ocean environment upon which naval systems are developed and perfected. The program itself is composed of a number of identifiable efforts designed to meet the Navy's needs for knowledge and understanding in such areas as ocean dynamics, air-sea interaction, chemistry of the ocean, Benthic boundary studies, sea floor topography and sediment studies, crustal and subcrustal studies, oceanic biology, underwater sound, and scientific platforms and instrumentation. We have recently prepared a report of our ocean science program for the President's Commission, and copies have been forwarded to your subcommittee staff.

The Assistant Oceanographer for Ocean Engineering and Development is responsible for major activities which impact not only on our military capability but on all activities under the sea. The largest of these is the deep submergence program, designed to give the Navy a capability to operate at any depth, location, and time within the ocean, which includes:

(1) The deep submergence systems project, which will develop submarine escape, location and rescue; small object location and recovery; large object salvage; and increased diver working ability (man-in-the-sea). It also includes effort on the deep nuclear research submarine, the NR–1.

(2) The deep ocean technology project, which is specific advanced development effort in ocean engineering and technology covering such

things as power sources, materials and structures, sensors and sea floor engineering. The results of this development will have a major impact on all underwater work for whatever purpose. It is the Department of Defense area of emphasis in the national program, described by Dr. Wenk.

(3) The assessment and development of deep research and survey vehicles, which will enable us to study and collect data in the heart of the ocean environment.

(4) A biomedical research effort of major proportions, lest the accomplishments in undersea technology far outstrip man's ability to use them.

In addition to deep submergence, the ocean engineering component includes a wide range of development programs carried out by Navy laboratories in support of their basic missions; and an advanced development effort in support of environmental prediction.

The Assistant Oceanographer for Operations, whose functions I am temporarily carrying out, is responsible for that part of the program consisting primarily of a variety of oceanographic and hydrographic surveys conducted in all ocean areas to provide critical environmental data, charts and publications necessary to support key naval operations including Vietnam, ASW, Polaris/Poseidon, mine warfare, amphibious, and general fleet activities to insure the combat readiness of the Naval Forces, as well as to satisfy the statutory requirements to provide environmental data, charts, and publications for our merchant marine. He also has responsibility for technical direction of the oceanographic support so necessary to many salvage and search operations.

FISCAL YEAR 1968—NAVY OCEANOGRAPHIC PROGRAM HIGHLIGHTS

A summary of the oceanographic program by the various appropriation categories follows. It should be understood that the program is basically a crosscut of other line items, with pertinent effort collected here for management, coordination, and direction as part of the oceanographic program, but actually justified elsewhere. It is our intent to give maximum visibility to the oceanographic effort, to best serve the national interest.

NAVY OCEANOGRAPHIC PROGRAM (CONGRESSIONAL SUBMIT)

[In thousands of dollars]

	Fiscal year 1966	Fiscal year 1967	Fiscal year 1968
R.D.T. & E.	78,849	87,192	108,966
SCN	26,200	33,700	16,600
MILCON	0	3,000	106
OPN	7,137	14,105	26,931
O. & M.N	45,186	79,486	87,181
MPN	9,755	9,530	9,443
PAMN	327	326	410
Total	167,454	227,339	249,637

NAVY OCEANOGRAPHIC SHIPBUILDING PROGRAM

Fiscal year 1966: One large survey (AGS) class (in-house Navy use); two small oceanographic research (AGOR) class (new design, institution use).

Fiscal year 1967: Two medium AGS class (in-house Navy use); 1 medium AGOR class (new design, institution use).

Fiscal year 1968: Two small AGOR class (in-house Navy use).

These ships will provide modern, versatile facilities to meet the demands of oceanographic research, development, and survey programs.

Our program for fiscal year 1966 totaled $167.5 million. For 1967, it totaled $227.3 million. We expect to go forward at a level of about $235 million in fiscal year 1968, vice our budget request of $250 million.

The effects of the military appropriation cuts are still being apportioned at the lower levels which involve some of our projects, so our 1968 figure is still not yet firm.

In the ocean science segment of the program, knowledge important to both the design of undersea systems and the operations of naval forces is being developed within the scientific community. A few examples of scientific oceanography problems related to military progress are particularly interesting. We have strengthened programs of research concerned with effects of marine scatterers on acoustic propagation. Because of the adverse effects such scatterers have upon submarine detection equipment it is important to understand their distribution and character. Worldwide marine geological and geophysical investigations have delineated sediment patterns and characteristics that affect sonar equipment performance. The critical influence of bottom topography and sediment structure on the newer sonar systems and on ocean bottom structures will require further strengthening of the Navy program in this field during the coming years. As our weapons systems have become more sophisticated, the need for predicting the influence of the ocean environment on their performance has become essential to their proper employment. Two large-scale and long-term scientific efforts were begun in fiscal year 1967 to study specifically the variability of the oceans and their dynamics. The field programs for these studies will press forward this year, investigating the causes of large-scale physical changes in the upper layers of the North Pacific Ocean and the dynamics of large oceanic systems in the North Atlantic Ocean.

One long-term development which will contribute significantly to these studies is the ocean data station. This is a buoy system designed to obtain and transmit oceanographic data from anywhere in the world's oceans. As national and naval needs for oceanographic data collection networks expand over large sections of the world's oceans in future years, the results of this development can be expected to make a valuable contribution.

Through cooperative efforts, the Navy derives greater benefits than would be possible by its resources alone, and, in turn, the Navy contributes to programs of other agencies. Examples of such efforts are the studies of the Eastern Tropical Pacific (EASTROPAC) in which ONR contract scientists are cooperating with Bureau of Commercial Fisheries and Coast Guard scientists, and the Barbados air-sea interaction study now being planned in which ESSA will be primarily responsible for atmospheric measurements and the Navy for oceanographic aspects of the program. The Navy gains in both data and scientific techniques from such ventures, as do the others concerned.

The ocean engineering and development efforts of the Navy mentioned earlier center around the deep submergence program, which includes the deep submergence systems project (DSSP); deep ocean technology project (DOT); the assessment and development of deep research and survey vehicles, and biomedical research. In addition to this broad program, an important individual supporting role is performed by the Navy laboratories and systems commands.

The Navy is operating increasingly complex nuclear powered and nuclear armed submarines to such great depths that lives and classified equipment are placed in jeopardy in the event of a submerged accident. We are developing the capability to rescue personnel from submarines in distress to the maximum depth required. We must develop the capability to examine and salvage as necessary damaged submarine and other hulls for purposes of accident investigation and to protect classified military information.

Major test range facilities are presently emplaced on the ocean bottom and on the continental borderlands, and commercial enterprises and Government interest are expanding operations on the continental shelves. There is no operational capability to police the sea floor of our own continental shelves or to cope with contingencies, despite the fact that the need grows greater rapidly. This capability must be developed, as well as the capability to inspect, repair, and defend our own existing installations, both Navy and commercial, in deeper water. Looking at the area from a purely military viewpoint, it is vital that we develop technological options in order to make optimum use of sea-based deterrent systems as the changing threat dictates.

The objective of the deep submergence program, as I said, is to give the Navy the capability to operate at any depth, in any location, and at any time within the ocean. An important part of the DSSP component of this program is the development of the capabiilty to rescue personnel from disabled submarines on the ocean floor at any depth to the collapse depth of the most modern combatant submarine. Rescue will be effected by mating a small deep submergence rescue vehicle (DSRV) to the hatch of the disabled submarine. The first DSRV is under construction and will be operational in fiscal year 1969.

As a result of the tragic loss of *Thresher* and the recent lessons learned during the successful recovery of the unarmed nuclear weapon lost off Palomares, Spain, plans are proceeding for the development of a 20,000-foot deep submergence search vehicle. The most urgent problems associated with the 20,000-foot vehicle are in the technology of hull structure materials and flotation materials. Fabrication techniques for welding, forming, and machining Hy-210 steel and titanium-120 alloys are being developed. In fiscal year 1968 this development will continue with steels having yield strengths of 180,000 to 210,000 pounds per square inch and titanium alloys in the range of 150,000 to 180,000 pounds per square inch.

Also within the scope of the deep submergence systems project, the man-in-the-sea program is advancing our capability for man to live and work in the oceans. *Sealab III*, to be conducted in calendar year 1968, will demonstrate the ability of men to live and work for extended periods of time exposed to ambient pressure at the outer edge of the continental shelf. Tools and equipment for performing useful work will be developed and evaluated in this program.

As an adjunct to the deep submergence systems project, the *NR–1* will be the first nuclear powered deep submersible. This ship is being designed and constructed under the project managership of DSSP with powerplant development under the management of Director, Naval Reactors Branch of the Ships Systems Command, Vice Admiral Rickover. The *NR–1* will be capable of operating for long periods at an extended depth with her crew of five plus two scientists. In addition to demonstrating the capability of nuclear power in the deep ocean, *NR–1* will be fitted with a full suit of instruments for oceanographic research. She will thus become the first deep submersible with a sensor suit capable of extended operations.

The deep ocean technology (DOT) program which is included in the 1968 budget will advance the development of technology leading toward the occupation and exploitation of the deep ocean. As I noted earlier, this program was singled out as the single DOD area of emphasis in the President's report to Congress on the national marine science program. Problems to be studied include the development of fuel cell powerplants as a prime mover for deep-diving submersibles. The cells are expected to provide for quiet, reliable, long-endurance operation of small, highly maneuverable vehicles. The program envisioned will provide for an operational fuel cell powerplant for deep submersible application within 3 years from the initiation of the effort. Further, since present submersibles are propelled by electric motors, which are all either encapsulated or unreliable, the development of reliable submersible motors is mandatory and will be an initial effort of DOT.

The *Curv*, which you will recall as the unmanned vehicle which attached the recovery line in the Palomares operation, is now being reengineered to increase its depth capability almost threefold, to 7,000 feet. Later in the DOT program, a 20,000-foot *Curv* will be developed.

For operations at great depth, materials having a high strength to weight ratio are needed and massive glass is considered to be a major contender in this area. Glass may be suitable for flotation material or as hull material if problems associated with attachments and penetrations can be overcome.

The advanced development of tandem propeller propulsion plants will enhance the maneuverability so vital to deep submersibles in near-bottom operations.

The development of sea-water hydraulic systems to provide for improved reliability of deep ocean machinery and vehicles is also a longer term goal of the DOT program.

Engineering studies are being conducted to determine the feasibility and problems associated with the development of a one-atmosphere sea bottom habitat at 6,000 feet. Associated with these studies is the development of facilities for handling loads up to 150 tons in the deep ocean and the development of explosive anchoring devices for securing these sea bottom emplacements. Development of a sea bottom habitat or deep ocean laboratory will provide for substantial improvement in the broad technology of ocean engineering and facilitate the development and testing of equipment to further extend our capability in the ocean.

OCEANOGRAPHIC OPERATIONS

Oceanographic operations will continue in support of fleet operations and research and development. Oceanographic and hydrographic survey operations in support of Vietnam are particularly necessary to provide services (data, nautical and combat charts, and publications) for the specialized needs of amphibious operations, mine warfare, and inshore/river patrol activities as well as for the massive logistic support by the merchant marine. We now have five ships assigned to these surveys.

The large hydrographic, oceanographic and geophysical survey programs which have supported strategic deterrence forces such as

POLARIS/POSEIDON since their inception, will continue. The next most urgent and critical oceanographic operational support will continue to be applied to naval problems in antisubmarine warfare. The Antisubmarine Warfare Prediction Service (ASWEPS) now becoming operational will act as a seaborne service for the hunter-killer groups by providing environmental data in the detail and timeliness needed for tactical operations. In addition, ASWEPS will support long-range shore-based ASW patrol aircraft.

The worldwide marine geophysical survey program begun in fiscal year 1966 is also continuing into 1968. These surveys, conducted under Navy contract with two commercial geophysical companies, will, when completed, have covered 16 million square nautical miles, or 15 percent of the total ocean. Data on oceanographic conditions existing in deep water masses and at the water/bottom interface, needed to optimize the effective operational employment of the newly developed sonars, are being collected.

Long-range sound propagation is being studied, both by operational surveys and by research in the ocean science program. Noises in the sea can be heard in some areas for great distances with considerable regularity. It is of utmost importance to understand such propagation. The comprehensive program to deal with this problem will continue and the development of instrumentation and techniques in its support will be pursued.

I wish to mention also one project which, though not developed as an oceanographic project, will make a major contribution to the national oceanographic program as well as to our military capability directly. This is the Navy-developed satellite navigation system which is now operational and has increased the available accuracy of position for ships at sea by an order of magnitude. The Vice President has just made this system available to the U.S. academic and private industrial communities.

I have reviewed briefly the major program areas of Navy involvement, in the context of their applicability to military and certain nonmilitary needs. We in the Navy were particularly pleased to note the general endorsement by the President's Science Advisory Committee, in their report last summer, of much of the Navy effort in ocean science and engineering, and the concurrence in our firm belief that the national security needs for oceanography are, and will continue to be, a dominant force in shaping the Federal program for the next 5 to 10 years.

We support the President's "lead agency" concept for coordination of efforts which are of substantial multiagency interest, and we recognize the importance to the national good of the Navy support of marine technology. Each of our major Navy projects offers several potential applications beyond their direct military objectives: deep submergence search and rescue vehicle technology provides the basis for any vehicle end use—mining, fishing, salvage, mechanical work, research, and data collection; sonar technology can lead to considerably greater efficiency for future generations of commercial fishermen at a time when the problem of feeding the world population will have increased; man-in-the-sea may provide a key to greater and more rapid development and exploitation of all our underwater resources, especially those on the Continental Shelf.

The Secretary of Defense, through the Director, Defense Research and Engineering, has stated the policy that in addition to meeting national security objectives, the DOD has an obligation to serve the national interest in any area where the Department's capabilities and the national needs are closely matched. He has accepted the national responsibility in ocean technology, and has offered to accept the national mission in oceanographic environmental prediction and oceanographic test facilities. If national objectives require it, the Department of Defense has expressed its willingness to request funds from Congress even though the work is not directly related to defense needs, and to take direction for utilization of these funds from a non-DOD organization if this would be the best course.

The Navy is strongly alined to the defense concept, for we are convinced that the interests of the Nation as a whole are best served by a strong cooperative effort among those Federal agencies concerned with the sea. It is not the Navy's wish to wrest programs from agencies pursuing them in support of their individual missions. It is our wish to cooperate to the fullest in all areas where we can make a substantial contribution to the success of an effort, and to make available to the Federal and private sectors those of our unique facilities which can be of real service. We are investigating fruitful areas for bilateral and multilateral programs with other agencies, and are taking steps to insure that the maximum amount of our data, science, and technology is made available to those in government, industry, and academic institutions who have a need. We are quite proud that in the area of ocean technology, where our own need is great and our program responsive, our efforts hold so much promise for the general good.

In closing, I would like to emphasize the obvious fact that the oceans are peculiarly the Navy's province of operations. As a result we fully appreciate that our continued advancement in oceanography is a necessary part of military preparedness. I ask that you give the program your full support in order that we may continue to move ahead in our understanding and utilization of this complex environment. We, in turn, will continue our unrelaxed effort to enhance both national security and the peaceful exploitation of this great portion of the surface of the earth for the benefit of all.

Mr. Lennon. Thank you, Admiral Waters, for a very fine statement.

For the record, would you introduce the gentlemen sitting with you to your right and left?

Admiral Waters. On my right is Captain Snyder, who is the special assistant to the Assistant Secretary of the Navy for Research and Development, Dr. Frosch.

On my left is my Special Deputy for Oceanography, Capt. T. K. Treadwell.

Mr. Lennon. We have had the pleasure of their acquantance before, but we wanted their names to appear in the record.

I recognize the gentleman from Washington, Mr. Pelly.

Mr. Pelly. Thank you, Mr. Chairman.

Admiral Waters, I want to commend you for a very fine statement. I think anybody who listened to what you said will realize that this whole program is much more comprehensive than the general public might be aware. It is a huge program. I seem to sense from your testimony that you have some apprehension that possibly vital investigations concerning national security might be turned over to some purely civilian agency that could be set up. That same fear occurred in connection with the Defense Department when NASA was established.

Am I right that you are fearful and you are going to great pains today in order to stress the importance of this?

Admiral WATERS. I would not say fearful, sir, but this is always a possibility. I think anyone with a clearly defined mission has found from experience that he must control all of the tools to perform that mission. This is the point we were making.

I think it equally apparent that, for instance, the Bureau of Commercial Fisheries, which is so heavily involved particularly in marine biology and the investigation of the oceans to improve fish catches, must be permitted to do their work. In other words, mission-oriented activities must retain control of the type of investigation which needs to be done, although we strongly advocate cooperation among these agencies.

Mr. PELLY. It appears clear that the Navy might be the NASA of the sea through its exploration. I think there will be considerable opposition to that concept because so many of the programs are not connected with defense. I think you have certainly stressed in your testimony—and I think you purposely indicated it—there is a duplication and overlapping in many of these areas. Is that true?

Admiral WATERS. I would say, rather than overlapping, sir, that the great bulk of the things we have to do for national defense also have uses elsewhere.

As an example, I gave the man-in-the-sea program. If you are going to put things down in the ocean, you want to get man as far down there as possible because, obviously, he can make things work better. You have the human mind down there. At the same time, the point I was making is that these developments which come out of the man-in-the-sea program are equally applicable to any other operations on the bottom which might be done by the petroleum industry, the mining industry, fishing, or whatever. They are available, and we do our very best to make them available.

Mr. PELLY. Is it not true that the real emphasis on oceanography came with President Kennedy but he, on the other hand, was very dubious about setting up a single agency such as we did for the exploration of space?

Admiral WATERS. So I am, sir. I think you could draw that inference from the brief description I gave you of the Navy organization that has evolved over the last 2 years. We studied this thing very hard. I think the Navy is just really a smaller example, if you will, of the national problem. We have efforts in the marine sciences spread throughout the Navy. They have to be, for oceanography is not an end in itself. It is a supporting function.

For example, the people who are making homing torpedoes have to know about the ocean, but they have to know different things than the man who is designing, say, a long-range sonar. So, we do have in our laboratories different groups of people oriented in slightly different ways toward the sea.

We looked at the idea of trying to combine all of these people in one place for reasons of efficiency and saving money, and came to the conclusion that it would do much more harm than good and probably cost more in the long run. So we went the other way, leaving all of the organizations where they are and drew them together with this small management staff that has been created under me in the Office of the Oceanographer.

We let those people do their work, and my job is just to make sure that they do it well and efficiently and as cheaply as possible and contribute to the naval program as they should, but we do not tell them how to do it.

Mr. Pelly. I do not know where we would be today if it had not been for the Navy and the tremendous amount of money they have put into this research work. We do not know what might develop when the report comes from the President as to a recommended organizational setup. I know your testimony here today will be an invaluable aid to many of us in our thinking when the program comes to Congress.

Thank you very much.

Mr. Lennon. The gentleman from Virginia, Mr. Downing.

Mr. Downing. Admiral, your statement is so comprehensive and complete that I have only a few questions to ask. I think you have covered the subject in an excellent manner.

Admiral, what degree of coordination is there between your office and the various Federal agencies which are delving into oceanography within the Government? Is there coordination of effort?

Admiral Waters. Yes, sir, there is, in several different ways. Up until recently we had the Interagency Committee on Oceanography, on which all of the agencies who have an interest in the ocean were represented and which was chaired by the Assistant Secretary of the Navy for R. & D., Dr. Frosch, that served as an effective forum for getting everyone together. It lacked, I think, the authority to compel decisions, but it did a great deal of good.

This committee has been superseded through reorganizations that were directed by the new National Council and split up into about five committees. Those committees are just getting going. I believe Dr. Wenk, as I remember reading his testimony, told you about that reorganization. So they do exist, but they are really just getting off the ground, so to speak.

In addition to this sort of coordination, in areas where there is an obvious similarity in the need for various types of information, we have formal and informal types of agreements with other agencies. For example, the Bureau of Commerical Fisheries in the Department of the Interior and the Navy have been working together for several years now, and we have come to the conclusion, quite dramatically, actually, that a great deal of the technical data that we send out in what we call our Antisubmarine Warfare Environmental Prediction Service, ASWEPS, to our forces at sea in order to find submarines, is very valuable to commercial fishermen. It helps them locate schools of fish, because the fish are essentially, to oversimplify it, temperature-sensitive. We have had experiments conducted with them to the point where the results have been so favorable that we are just on the point of signing a formal agreement with the Department of the Interior as to who will do which part of which program and how we will go about helping each other.

At the same time, the work that they do in studying fish and fish habits and fish migratory habits is very valuable to us, because many things in the ocean can be a false target to an antisubmarine operation, and the more we know about the deep scatterers and the migration of fish, the more accurately we will be able to predict where they might or might not be and where they will cause us trouble. So, the thing works two ways.

That is just one example of what is now getting to be a formal agreement, and which has been an informal arrangement. We have several others like that.

Mr. DOWNING. Admiral, although you go a great deal into oceanography, I would think your primary function is concerned with defense. In what areas do you not penetrate so far as oceanography is concerned? For instance, do you do any investigation into the area of minerals on the bottom of the ocean?

Admiral WATERS. We do obtain information which is valuable to people interested in minerals because we are interested in the geology of the bottom, the structure of the bottom, because our newer and more powerful sonar systems use the bottom. Sound waves reflect off the bottom, so bottom conditions affect the performance of the sonar. We are conducting what we call a worldwide survey—it is the one I mentioned covering 15 percent of the world's oceans—to determine the roughness of the bottom, the reflectivity, the sedimentation, all of which affect sound propagation.

These same data, this same information, are of great interest to people looking for minerals and oil. It is a help to them.

Mr. DOWNING. But you are not concerned with the extraction of the minerals or their economic value.

Admiral WATERS. No, sir. We do not want to be in the fish business, or the oil business, or the mining business; but we do think the information we have to get to carry out our defense mission is valuable to many other people and most of it is valuable to others. Surprisingly enough, a very small percentage of it has to be classified, particularly in the raw data form in which they want to use it. We make every effort we can to keep it from being classified.

There are some things, of course, that we have to classify. It is pretty hard to give you a percentage, but we think it is around 90 percent unclassified.

Mr. DOWNING. Is your progress in the propagation of sound classified?

Admiral WATERS. Some of it is; yes, sir; but most of the collected environmental data we can at least sanitize so it can be used.

Mr. DOWNING. You are making progress in that?

Admiral WATERS. In the propagation of sound; yes, sir; in the study of the propagation of sound, particularly long-range sound. This is something which we have had to do. It is an expensive thing to do. It goes back to history. The history of oceanographic investigation will tell you that people went and studied the ocean where it was comfortable to do so. Therefore, we know a great deal more about the waters around Bermuda and the Mediterranean Sea in the summertime than we do about the cold North Atlantic and the rough North Pacific in the winter. That is where we are having to get information now.

Mr. DOWNING. Did I understand you correctly to say you had some concern over the establishment of an overall Federal agency for oceanography?

Admiral WATERS. No, sir; not the establishment per se. We, of course, are concerned about what form it takes. We feel there should be an organization that will coordinate and improve the general realization of the national program goals.

Of course, in answering this question I realize I am sort of preempting the Council and the Commission you gentlemen created, so probably I should not have answered it at all.

I can say that the Navy is in a very fortunate position here. We have a very unambiguous mission. We just want to carry out that mission. We do want to see a Federal organization established which will allow us to carry out our mission and contribute to the national program to the maximum extent possible.

Mr. DOWNING. Admiral, I think you have made a great statement. Like Congressman Pelly, I deeply appreciate the fact that the Navy has been in this field for so many years and has led the way. I thank you.

Mr. LENNON. The gentleman from California, Mr. Reinecke.

Mr. REINECKE. Thank you, Mr. Chairman.

Admiral, I am very much impressed by your statement, too. I have a couple of brief questions.

You mentioned the possibility of getting down to 20,000 feet. Would you care to comment for the record on your opinion of the proposed resolution which would reserve everything beyond the Continental Shelf to the jurisdiction of the U.N.? I think we would know your answer, but we would like it for the record.

Admiral WATERS. I can give you the official Department of Defense answer, which would be my personal answer, too, and that is that for obvious defense reasons we are against it, and also, certainly, I think anyone who works in this sort of business from day to day realizes that it is very premature to try to do anything about deciding who is to own the deep ocean bottoms, because we really do not know what is there. In other words, we would be making a decision from the standpoint of ignorance, and this is an unwise thing to do.

Mr. REINECKE. Thank you.

You went to great lengths in your statement to clarify the point that you feel the Navy has a dominant role in this overall national program, and that you would not mind helping other interested agencies or other interested industries—mining, salvaging, et cetera.

I am concerned, however, as has been expressed here by other people, about the possibility of this so-called lead agency concept that you heard here. This is not quite like space, where there would not be much work if it were not for NASA. I am thinking in terms mostly of private enterprise, independent exploration and involvement. Are we not asking for a situation here where everyone will wait and see what the Navy does? Are you not apt to some degree to stymie the motivation for private industry to get out and do for itself? As a result of your leading position and your proximity to large funds, they can just as well wait and see what you come up with, and then take from your finding accordingly.

Admiral WATERS. I do not think that is really a very strong possibility, sir.

Mr. REINECKE. How about the problem of patents and copyrights and particularly the location of mineral deposits? If a branch of the Federal Government comes up with these, obviously they should be protected for public dominion or world dominion or whatnot, depending upon location. Will this not in itself deter private exploration?

Admiral WATERS. We do not actually get into the location of mineral deposits. As I said, we get into the business of the geological structure of the bottom. As far as having information so we can tell people, "You will find gold here, and so-and-so there," we do not go that far into it.

We do have the data available for industry that might help them, probably with some extra effort on their own part, make an intelligent decision on what parts of, say, the Continental Shelf they would be interested in leasing when they are put up for bid by the Department of the Interior. This is the way it works. We do not say, "There is oil off so-and-so, and you should lease that." We say, "These are the data, and they were obtained with some of your tax dollars and you are as entitled to them as anybody else."

Mr. REINECKE. I am thinking of the case of the Department of the Interior, which had a run going up to Alaska looking for manganese nodules. If these findings were made available, who would have title to them?

Admiral WATERS. That would, of course, depend on where they are, sir. If they were manganese nodules, they are probably in the deep ocean and that is one subject. But if they are on the shelf, they are subject to lease through the regular bidding techniques through the Department of the Interior.

Mr. REINECKE. I tend to agree on your position on this but I am cautious we do not in some way stultify any private investment exploration.

Admiral WATERS. I think it would rather tend to encourage them because I think that it is a very risky venture to begin with. You have to have a lot of risk capital to go off out in the ocean. Look at fellows who are a little bit nervous today down in the gulf with all of those offshore oil rigs there and a hurricane coming up the gulf. It is that sort of thing that makes it risky, and the fact you may or may not find anything. You have to explore first.

I think if some spinoff such as small submersibles, research vehicles, improved alloys and that sort of thing make it easier and cheaper for the industrial outfit to get in, then this is going to encourage their expansion into the oceans rather than discourage them.

Mr. REINECKE. Would your office encourage the so-called lead agency concept here to take over the program?

Admiral WATERS. Not necessarily, sir, but certainly, sir, there are many areas where the lead agency concept will work. I do not know whether they need a lead agency concept plus some sort of a coordinating board or what.

I think that is really up to the Commission to decide. The lead agency concept does work and works very well in our experience.

For example, the Coast Guard was given the lead agency role about a year ago in the study of all offshore deep-water buoys for all agencies interested in them, and they have done an excellent job.

Mr. REINECKE. On August 6 the Washington Post ran an article and I quote:

> A Presidential Task Force is planning the future development of oceanography in government and a separate federal agency to explore and develop an oceanographic program is under consideration.

Do you know what this task force is?

Admiral Waters. Unless they are referring to the President's Commission or perhaps the National Council staff.

Mr. Reinecke. The reason I ask that, we have had some bitter experience on one other task force before this committee and we are wondering if there is another task force.

Admiral Waters. Not that I know of. Of course, the National Council staff and the Commission keep up pretty busy these days obtaining information.

Mr. Reinecke. Thank you very much, Admiral. It is a fine statement. We are grateful to have you here.

Mr. Lennon. Off the record.

(Off the record.)

Mr. Lennon. Mr. Keith?

Mr. Keith. Thank you, Mr. Chairman.

I regret I could not be here in time to hear your testimony, Admiral, nor was I able to hear Dr. Wenk in toto. I do have a question on the resolution which I will waive for the later executive session.

I would like first to ask you if you have any comments concerning the wisdom of establishing marine sanctuaries to inhibit widespread exploitation of the ocean bed mineral resources which might in any way adversely affect fishing resources or recreational values. In other words, is it possible to establish some kind of undersea zoning, perhaps similar to the wilderness concept?

Would there be some advantages flowing from such a policy?

Admiral Waters. Yes, sir; I think so. I certainly think that the shotgun approach should be avoided in either designating areas for exploitation or in establishing preserves, and that there should be some body of knowledgeable opinion who could pick the location. I think there is a need for it.

As you have indicated, we all recognize there are going to be conflicts between the various industries, recreation, and maintaining inviolate a sort of naturally preserved wilderness where the undisturbed flora and fauna and the physical characteristics can be continuously studied. There is a need for this. I agree with you it should be very carefully considered.

Mr. Keith. Would you not agree in the absence of such policy that anybody prospecting for oil in that area would feel they had the right to develop whatever their research turned up, if they discover in the midst of some fishing grounds some mineral resources?

Admiral Waters. Yes.

Mr. Keith. One rather specialized question, representing as I do Woods Hole, the home port of the *Alvin*.

Mr. Downing. Would you explain that?

Mr. Keith. I do not think it needs an explanation to anybody on this committee, but it could be. I think it important for the members of the subcommittee to be aware of the present level of technology in the field of oceanography, and I think we must view the current state of technology in a broad sense, but I would like to have Admiral Waters comment on this.

Let us assume we have an officer in command of our most modern vessel for oceanographic research and he has available to him all the support that we can give him, and he finds an object on the ocean floor that weighs 15,000 pounds, at a depth of 5,200 feet. His mission is to bring the object to the surface within 3 days.

Could he accomplish this mission? If not within 3 days, how long would it take him? And is there any other country that would be capable of accomplishing this mission within 3 days? And, if not, how long would it take them?

This is the kind of problem we were faced with and we learned a lot. I notice a little smile in the audience, but we have learned more by reason of operations similar to that which I have described here and which could not be successfully concluded in the time frame that I referred to. So I would appreciate it if you could give us an answer on it.

Admiral WATERS. I would say quite definitely "No," that we could not do it and as far as we know I do not think anybody else could do it.

The thing that makes this problem outside of the realm of present technology is the weight of the object. Did you say 15,000 pounds?

Mr. KEITH. Yes, I did; at a depth of 5,200 feet.

Admiral WATERS. If it were small like the bomb was, that sort of thing, we could handle it, but anything 15,000 pounds and the state of present technology, we could not. We have an ongoing project on this particular idea to obtain this capability in the Deep Submergency Systems project; that is, getting the heavy weight off the bottom, though not at the depth you noted. But it is the one with the least priority and in these days of scarce money, it will probably go much more slowly than the rest of them.

Mr. KEITH. I have to return to my committee, but I appreciate your answer and I do think it is a capability which will soon be within the realm of possibility.

Admiral WATERS. The recovery of small objects is something that does worry us very much and particularly their location. We keep having these problems that confront us, ones that make the newspapers and ones that do not. We have developed some interim capability.

We are attempting right now to increase that capability in the deep submergence program.

Mr. LENNON. The gentleman from California, Mr. Hanna.

Mr. HANNA. Thank you, Mr. Chairman.

I want to particularly pay my respects to the admiral for bringing to our attention the cooperation and coordination that is gradually being worked out through the agencies.

Mr. Chairman, I could only wish that kind of coordination and cooperation existed here on the Hill. I will make reference to the specifics on that later.

It would seem to me if you want to make multilateral use of the technology developed in singular missions and protect against the multilateral effects because of the ecological relationships in the sea, you have to have this approach you are talking about, whether a lead agency or some other concept.

I might make this observation: While I have been in this business there is usually a great distinction between the approaches made by a politician and the approaches made by business on a new idea. The politician looks to the pattern shop and finds something that exists and then tries to make that pattern which comes out of an old situation apply to a new one.

So the first thought is, if you are going to go into the sea you now have NASA in the pattern shop and you have something to work with.

I notice in contrast private industry finds their comfort—and that is actually what the politician is looking for, comfort and understanding of the situation—they find it by keeping the name of the game the same. When we rode in the stagecoach we called it a coach, when the trains came along and had a new way of traveling, they kept the coach, when the buses came along the first buses I ever saw that carried people were called coaches.

I notice when you go on a streamlined jet you still get a ticket on the coach. So they provide the name is the same as the game goes on, and I wish the politician would adopt more of that technique rather than the pattern shop technique. I think we have to find, Mr. Chairman, either the lead agency technique or a new concept that will give the taxpayer the maximum bang for the buck or at least the maximum coverage for his cash. He is entitled to getting everything out of these singular missions that is possible.

Let me ask you a specific question and bring up this business of coordination and cooperation on the Hill.

Are you aware of an organization in the Navy called NOTS?

Admiral WATERS. Yes, sir.

Mr. HANNA. Does that come under your responsibilities, Admiral?

Admiral WATERS. The one that used to be up until a few weeks ago called NOTS Pasadena was under my aegis, so to speak, in a limited way. They are one of the laboratories that have as a part of their broad program things that contribute to this overall program I manage.

Mr. HANNA. I notice you made reference to Dr. Frosch and it was my understanding he had a very singular connection and important connection with NOTS' operation; it that correct?

Admiral WATERS. Yes, sir.

Mr. HANNA. And it does come under the research-and-development aspect of the Navy, right?

Admiral WATERS. The point I was making it that NOTS China Lake is really oriented toward air-type weapons, NOTS Pasadena was an outgrowth of that which went into the water mainly with torpedoes, and now in the new organization NOTS Pasadena is called the Naval Undersea Warfare Center and draws on the capability of certain scientists and engineers located in San Diego at the old Naval Electronic Laboratory. They have been grouped, so to speak, as a task force.

related to ordnance or weapons in the sea, it has to relate to ocean-

Mr. HANNA. Whatever mission they have in terms of whether ography; does it not?

Admiral WATERS. Yes, sir.

Mr. HANNA. To the science of oceanography?

Admiral WATERS. Yes, sir. Please understand that I do not manage the development of weapons systems, however, only the environmental or ocean engineering in their support.

Mr. HANNA. If you would provide us with what you know about the plan for the expansion of their capability in R. & D. and how—

Admiral WATERS. You are referring specifically to the Naval Undersea Warfare Center at Pasadena?

Mr. HANNA. Yes.

Admiral WATERS. I shall be glad to. The Navy's plans for the R. & D. functional capability of the Naval Undersea Warfare Center have been and will continue to be primarily concerned with the Warfare area. Secondly, there will be work supporting the undersea warfare functions in several scientific and technological areas, among them ocean sciences and technology. The original balance of strengths to be developed was based on a Navy proposal for establishment of the Center on the site of the U.S. Naval Air Station, Los Alamitos, Calif. However, since funds for construction of the necessary facilities at Los Alamitos are not included in the fiscal year 1968 military construction authorization bill (H.R. 11722), it is necessary for the Navy to reevaluate the entire situation. The role of the present Pasadena facility must await completion of this reevaluation.

Mr. HANNA. What cooperation and coordination does the Navy in general and your office in particular participate in relative to international problems of the sea or international aspects of oceanography?

Admiral WATERS. The Navy both by its role of major performer in the Federal marine science program and by its historical role of cooperation with its allies in addressing common problems, is engaged routinely in international cooperative efforts. Principal Navy cooperation and coordination in matters relating to international problems of the sea are channeled via the Department of State through regional military alliances such as NATO, CENTO, SEATO, and various bilateral or multilateral arrangements with our allies; support to international organizations and agencies to which the United States is a member, such as the U.N.-sponsored Intergovernmental Oceanographic Commission (IOC), the International Hydrographic Bureau (IHB), and Pan American Institute of Geography and History (PAIGH); and through conduct of worldwide scientific investigations in all areas of oceanography. Such efforts frequently involve ships, scientific personnel, and resources of many groups and countries as in the case of Eastropac, the eastern tropical Pacific study currently underway. My office acts for the Department of the Navy in administering and coordinating these international activities insofar as they relate to furthering the Navy's needs to better understand its principal operating environment.

Mr. LENNON. Mr. Roth?

Mr. ROTH. What role, if any, does your office play in the exchange of oceanographic data with other countries or international bodies?

Admiral WATERS. One of the major responsibilities of my office is that of providing support to the Department of the Navy in the administration and coordination of international agreements designed to encourage exchange of many kinds of marine environmental data and related technical information.

In general this effort is conducted under U.S. treaty commitments such as the Antarctic Treaty and those with NATO, SEATO, and CENTRO; from U.S. membership and participation in specialized international bodies such as the Intergovernmental Oceanographic Commission (IOC), and the International Hydrographic Bureau (IHB); and from military exchange programs with our allies which provide for collective defense and mutual help by combining resources in these areas.

Mr. Roth. What is the source of your authority for making this international exchange of data, and is there, in your opinion, a need for further enabling authorities?

Admiral Waters. The authority for engaging in these international exchanges of oceanographic data is the individual treaty, or agreement to which the United States is signatory. On the whole, the present international mechanisms through which we operate to promote mutually profitable exchanges of oceanographic data are working quite well. Additional authority to pursue these efforts is not considered necessary.

Mr. Lennon. Mr. Keith?

Mr. Keith. Admiral Waters, you mentioned that the Navy is conducting field programs in the North Pacific and North Atlantic Oceans. Using these programs as examples, if another government or private agency seeks specific information from the location where these programs are being conducted, would it be possible for that agency to have the Navy obtain this information for it?

Admiral Waters. The Navy would be more than pleased to consider the needs of other agencies for specific information in the areas in which these, as well as other programs, are being conducted. Of course, it must be recognized that, in honoring requests for additional information from other groups, time and costs involved must be considered before definite commitments can be made.

In practice, the schedules of our ships and those of institutions we support have been included in the ICO document, oceanographic ship operating schedules, which is published annually. It has been the intent of this publication and our included schedules to advise people of the types and areas of operation being planned during the coming fiscal year for oceanographic ships. Hopefully, we can obtain greater use of the country's fleet of oceanographic ships by groups taking advantage of the published schedules in the manner you have asked about.

Mr. Keith. I would also like to know what efforts, if any, are made to coordinate with other agencies before the Navy begins a research project that is not of a classified nature.

Admiral Waters. Our unclassified research projects have been coordinated with other agencies through the panel structure of the Interagency Committee on Oceanography (ICO). The Research Panel of the ICO has served as the mechanism for such coordination. We expect that this type of coordination will now continue through the newly constituted Interagency Committee of Marine Research, Education, and Facilities (ICMREF), under the National Council on Marine Resources and Engineering Development.

Mr. Keith. The greatly increased use of civilian submersibles for commercial and recreational purposes is a virtual certainty in the not too distant future. Do you feel we are developing with sufficient speed a capacity for underwater rescue operations to deal with this situation adequately when it becomes a more serious problem?

Admiral Waters. As you know, the Coast Guard has the primary responsibility for safety and rescue of civilian craft on the oceans, although the Navy stands ready to assist whenever called upon. Presently the Navy is developing as rapidly as possible a submarine rescue system in order to provide the capability of rescue from fleet submarines with a deep submergence rescue vehicle (DSRV). The first unit of this system will be available to the fleet in mid-1969, and will, of course, be available to assist civilian submersibles at any time. However, unless civilian submersibles are built with the requisite hatch mating surface for the DSRV, this rescue system would have limited applicability except as a means to assist in salvage operations. There will also be available other civilian and Navy submersibles which could assist to the extent of their individual capabilities.

Mr. Lennon. Counsel, do you have any questions of Admiral Waters?

Mr. Drewry. Thank you, Mr. Chairman.

Admiral, would you please elaborate on your concept of a lead agency?

Admiral Waters. In selected areas of the Federal marine science program where substantial multiagency interests exist, the National Council has in several instances designated a single agency to assume major responsibility as a focal point of effort. This agency, in its lead role, reviews the overall Federal and private effort in the assigned area of responsibility, and initiates efforts, including budgetary requests, necessary to fill any critical gaps which become apparent. It does not become the lone performer at the expense of other agency programs, because oceanographic areas which most properly lend themselves to the lead agency concept are not ends in themselves but are done in support of various agency objectives. It is obviously important that the agency designated as lead, however, be the major performer in the specific field. I support this approach, which recognizes that the most cost effective approach is to place management responsibility where the major expertise already resides. I do not conceive of the lead agency as a device for extending Navy influence into other sectors of the Federal marine science program.

Assignment of lead responsibilities to the Navy for the national ocean technology effort resulted from a long-demonstrated preeminence and capability of the Navy to render effective service in this area. We have offered to accept additional lead responsibilities in oceanographic environmental prediction and oceanographic test facilities, areas in which we also feel eminently qualified.

I believe that as an interim measure, the lead agency role as conceived and implemented by the National Council is proving to be a most effective device for fostering the kind of cohesiveness among participating agencies needed to achieve vital national goals.

Mr. Lennon. Thank you, Admiral, for appearing here today.

Gentlemen, is the representative of Congressman Fascell, who is chairman of the Subcommittee on International Organizations of the House Committee on Foreign Affairs, in the audience this morning?

Is the representative of Congressman Fountain, of North Carolina, here?

Is the representative of Congressman Broomfield, of Michigan, here? If not, he will be permitted to come in and remain during the executive session.

Congressman Fountain and Congressman Broomfield are the two members who have been appointed as House observers and our representatives in the United Nations. Both of them are in New York today for the convening of the General Assembly, and, of course, their representatives are permitted to attend.

We will request now during a 2-minute recess that those of you who are not members of Admiral Waters' staff and associates of those members who I have just mentioned, members of the press and others will please retire from the chamber, and the representatives of the Council, Dr. Wenk, and representatives of the State Department will come forward.

(Whereupon, the committee proceeded to executive session.)

NATIONAL MARINE SCIENCES PROGRAM

WEDNESDAY, SEPTEMBER 20, 1967

House of Representatives,
Subcommittee on Oceanography of the
Committee on Merchant Marine and Fisheries,
Washington, D.C.

The subcommittee met at 10:10 a.m., pursuant to call, in room 1334, Longworth House Office Building, Hon. Alton Lennon (chairman of the subcommittee) presiding.

Mr. Lennon. The meeting will now come to order.

We have two principal witnesses here this morning, Arnold B. Joseph, marine scientist, of the Division of Biology and Medicine of the Atomic Energy Commission, accompanied by Mr. Stanley Seiken, program manager, Division of Reactor Development and Technology, and also a witness representing the Department of Transportation and, more particularly, the U.S. Coast Guard, will be Adm. W. J. Smith.

It seems to me imperative that we hear both of these agencies or commissions this morning, so at 10 minutes after 11, we will hear Admiral Smith, and I suggest to the members of the committee that they get real hard-core questions asked of the representatives of the Atomic Energy Commission.

Mr. Joseph, will you and Mr. Seiken come forward?

Mr. Joseph. Yes.

Mr. Lennon. Thank you, sir. The members of the committee are ready. Will you proceed, please, sir?

STATEMENT OF ARNOLD B. JOSEPH, MARINE SCIENTIST, DIVISION OF BIOLOGY AND MEDICINE, ATOMIC ENERGY COMMISSION, ACCOMPANIED BY STANLEY J. SEIKEN, PROGRAM MANAGER, ISOTOPE AUXILIARY POWER BRANCH, DIVISION OF REACTOR DEVELOPMENT AND TECHNOLOGY

Mr. Joseph. Mr. Chairman, thank you for the opportunity to appear before your subcommittee this morning to review and discuss the Atomic Energy Commission's ocean science and engineering research and development program.

Accompanying me this morning is Mr. Stanley Seiken of our Division of Reactor Development and Technology. Mr. Seikin and I represent the technical side of the AEC's operations which has intimate contact both with our research and development programs and with the staff of the National Council on Marine Resources and Engineering Development. We are in position to report, firsthand, on certain aspects of AEC's marine program which are of interest to this committee.

Mr. Chairman, I will stay fairly close to the written statement, except I will skip a few details in the interest of saving time.

Mr. LENNON. All right, sir, and without objection, your full statement will be inserted in the record.

Mr. JOSEPH. Thank you, sir.

In his testimony before this subcommittee 2 years ago, Dr. George M. Kavanagh, then our Deputy Assistant General Manager for Research and Development, briefly outlined the nature and objectives of AEC's oceanographic programs in relation to management's views on certain legislative proposals pending before your committee.

I would like to refer to and expand on Dr. Kavanagh's outline description of our marine programs to indicate the direction taken and progress made since then and their relationship to the Marine Council's goals.

As Dr. Kavanagh outlined, the AEC's marine-related research and development program is in three distinct areas, each of which is directly related to AEC's major mission of development, use, and control of atomic energy.

We do conduct a marine environmental science research program, and an ocean engineering program, which are directly related to oceanography; less directly related are our programs in food irradiation, including fish irradiation, water desalination and nuclear ship propulsion. I think it will be readily obvious that these programs are compatible with the goals of the National Marine Council.

The AEC's marine science research program is concerned with the effect of radioactivity which has been or may be released to the marine environment. Special attention is given to the means of transport of radioactivity through water and marine life into the human food chain. This program of studies is somewhat different from the usual single discipline approach to studying ocean problems. This program integrates marine biological studies with associated work in chemical and physical oceanography.

Of approximately 60 research projects in the marine sciences, about half deal with biological aspects; that is, either with radio ecology—the relationships of marine biota to radioactivity in their environment, or with radiobiology—the biological effects of radioactivity on various marine organisms.

The other research projects deal with geochemical aspects or with physical oceanographic aspects usually in a way that links chemistry and physics. All of them relate to radioactivity then in the marine environment.

Rather than try to indicate progress on each of these 60 projects, I will highlight selected projects and developments, which we think indicate the quality and scope of the AEC effort.

A substantial effort is supported in studies aimed at understanding, quantitatively, the marine food web. The AEC's interest in such work is intrinsic since, in order to predict the amount of radioactivity that will be taken up by fish in any contamination event, it is necessary to know the posible routes and the relationships of the added, radiochemical elements to those which make up the environment.

The sequence first requires an understanding of the natural system upon which are superimposed the modifying effects of the contaminants.

Food web studies are fundamental not only to the AEC's problem involving radioisotopes, but also to many other problems of understanding, using and controlling the sea and its resources. For example an understanding of the food web is necessary for predicting the effects of any other nonnuclear contaminant.

Also, if "farming" the sea is to be a reality, it is necessary to know the factors which make for optimum growth of desired species as well as those which are detrimental.

AEC contractors have made significant contributions over the past several years by way of developing instruments, and techniques for identifying and measuring nutrient cycles and trace substances necessary to life in the sea; also to distinguish living from nonliving organic substances.

An automatic analyzer system has been developed to determine nitrates, phosphates, silicates, and chlorophyll automatically and continuously on shipboard while the vessel is underway. This development should be a great aid in describing the reasons for the "patchy" distributions of plankton in the sea

AEC is also concerned with understanding the life cycles and distributions of fish populations in the sea in order to predict the uptake and possible effects of radioactivity both somatically and genetically, on the species.

Toward this end, AEC has financially supported projects with the Bureau of Commercial Fisheries in selected geographical areas of direct concern to AEC, that is, off the Columbia River and the aerospace launch pads on both coasts of the United States.

A spinoff of the Columbia River projects has been the discovery of a large hake population residing at several hundred feet off the coast of Oregon and Washington.

In a related project AEC is supporting work at Scripps Institution of Oceanography which is shedding light, literally and figuratively, on fish and shellfish populations, apparently thriving at depths below 1,000 fathoms.

Sea water, while one of the most abundant substances in the world, is an extremely complex chemical system. Worldwide fallout and other radioactive substances, natural as well as man made, which find their way to the sea are being employed to unravel some of the ocean's mysteries.

The vastness of the sea, coupled with its complex chemistry makes it extremely difficult to find and measure this radioactivity.

Physicists, chemists, and radiochemists, with AEC support, have invented instruments and developed techniques to measure extremely low concentrations of radioactivity and related trace elements in sea water. One such development is resulting in what appears to be a new understanding of chemical mixing in the sea. I personally consider this in the nature of a breakthrough in chemical oceanography.

An in situ instrument utilizing KCFC—KCFC is an acronym for a form of potassium cobalt ferrocyanide, a granular chemical sorber which selectively extracts cesium from sea water, is being used to measure vertical profiles of cesium-137—a radioactive fallout element.

In its first year of use in the Pacific Ocean, it enabled the detection of narrow-band concentration peaks some distance below the surface. Heretofore, it was assumed that the radiocesium had a more or less uniform gradient from the surface down.

In addition to this cesium work, the distribution of other fallout and natural radioisotopes is being studied to describe oceanic mixing and circulation processes in the Atlantic basin as well as in the Pacific.

In some work radioisotopes are purposefully introduced under controlled conditions and in limited amounts to study ecological relationships among plants, animals, water, and sediments. As it turns out this is one of the best ways to measure energy flow through the trophic levels and the cycling rate of nutrients into and out of the biota.

Radioisotopes are being put to work in instruments for scientific purposes. Many of these instrument developments are being made in cooperation with other Government agencies to assist them in their primary missions.

We have several projects in cooperation with the Naval Oceanographic Office. One involves the DWICA—a deep water isotopic current analyzer. This device, developed by the AEC, measures water current speeds as low as 0.002 knots and as high as 10 knots in water depths to 6,000 feet, a significant extension of range over mechanical current meters.

The principle of operation is to pulse out a small amount of short-lived radioisotope such as iodine-131 and measure it a fixed distance away with a radiation detector.

NAVOCEANO is assisting in field tests and further development of the device.

NAVOCEANO is also conducting field tests of an in situ sediment density probe. This device measures density of the ocean floor by measuring back-scattered radiation from a sealed gamma emitting source.

Once perfected, this unit will greatly speed up the search for ocean sites suitable for construction of offshore oil drilling platforms, bridge piers and emplacement areas for facilities such as the Sea Labs.

AEC has recently developed a new technique for tagging sands with a short-lived rare gas radioisotope and an instrument to measure its radioactivity, in place in the environment.

This system is being employed in a truly cooperative venture involving five Federal agencies—Department of the Army, Department of the Navy, Department of the Air Force, NASA, and AEC—and the State of California. The project deals with measuring littoral drift along the coast of California, especially in the vicinity of the aerospace launch facilities.

We think we have made a significant progress in our oceanographic nuclear power program. In the course of recent years, the military scientific, and commercial activities and interests of the United States have fostered the establishment of manned and unmanned remote bases and scientific sites in the polar regions of the world, in the tropics of Asia and Africa, on the surface of the oceans and very recently in the depths of the oceans. And I might add, in outer space as well, all of which require power or energy to operate.

Forecasts of future oceanographic power requirements indicate a need for wide ranges in such parameters as power levels, lifetimes, degree of maintenance, and attendance.

Although the full range of applications has not been defined, it is recognized that a variety of specific systems will be required.

The AEC has maintained close liaison with the agencies, institutions, and organizations involved in terrestial and oceanographic activities in order to assess the need and requirements. These discussions have made clear that nuclear power will materially enhance our country's ability to pursue many potential oceanographic and ocean engineering applications, and ultimately be a necessity for some applications.

The intrinsic characteristics of nuclear power systems, particularly their ability to operate under a variety of environmental conditions, justify their development and application not only from a logistic viewpoint but from an economic viewpoint as well. This effort is in keeping with our mission to develop new uses for atomic energy.

The recent and initial effort of AEC has been directed toward the design and development of the first generation of isotope devices in order to provide proof-of-principle. These first units were designated SNAP–7 (meaning Systems for Nuclear Auxiliary Power) and were powered by strontium-90. These devices have successfully demonstrated the feasibility of long-lived isotope power systems that are capable of unattended and safe operation in a variety of environments hostile to man. This development effort was completed in 1966.

Six first generation SNAP's, each providing 7.5 watts and 60 watts of electrical power, were placed in service in a variety of oceanic situations as indicated in the first table.

These were placed in a buoy, offshore oil platform, and in a lighthouse as navigation lights, also in a weather station in Antarctica, and in a Nomad buoy in the center of the Gulf of Mexico—which is a metrological station—and also at the bottom of the sea, in a depth of water of 15,000 feet, to provide power for a, a transducer for some Navy experiments.

These first generation units have been successful in demonstrating the capability of isotope power sources for long-term, unattended operation under severe environmental extremes without compromise to the health and safety of the general public or to marine life.

Of the six prototypes developed and tested, four were unqualified successes. The remaining two experienced failure of electrical components and so were only partially successful.

The success of the SNAP–7 program has had two important results: First, it has demonstrated to the oceanographic community the capabilities of isotope power which, in turn has resulted in an increasing demand for oceanographic nuclear power.

Secondly, the data and operational experience obtained from these prototypes have indicated where improvements in technology are required to develop a second generation of economically attractive energy sources.

We think that isotope power systems may be developed within the technology available in the next 2 or 3 years to be economically attractive for many more oceanographic and terrestrial applications. These include underseas navigational aids; ocean-moored buoys; seismological stations; unattended weather stations and military ocean-engineering missions.

To meet the primary user requirements of long life, demonstrated reliability, and cost effectiveness, the AEC has underway or planned, research and development programs of wide scope to meet many needs in a timely and technically sound fashion. These possible applications are summarized in the second table, headed, "Terrestrial Electric Power Development."

As may be seen, this program consists of four elements classified according to power level, isotope selection, area of application, and application criteria. The underlying objective is to develop a base of isotope power systems technology that will be applicable to a wide variety of marine and terrestrial applications within discrete power levels. The selection of these power levels is tied to a user need that has been identified to date. As future needs become defined, additional program elements will be considered.

Of greatest interest to oceanographic and ocean engineering activities, are the three highest power output units. AEC is undertaking to design, develop, test, and demonstrate isotopic power systems in the 100- to 1,000-milliwatt range for specialized military and commercial application including oceanographic instrumentation, underseas cable boosters, and underseas weapons activation.

A major research and development effort in fiscal year 1968 is directed toward the development of a series of compact and highly reliable isotopic power systems in the 10- to 100-watt power range.

It is planned that this program will lead toward the development of a second generation of radioisotope power systems that possess the required reliability, operating lifetime, and economic advantages necessary to achieve widespread applicability in marine and remote terrestrial environments. This program consists of two specific projects: SNAP–21 and SNAP–23.

SNAP–21 is a two-phase project to develop a series of compact strontium-90 power systems for deep sea and ocean bottom application.

The first phase of design and component development effort on the basic 10-watt system has been successfully completed; the previously mentioned SNAP–7 program.

A second phase systems development and test effort has been underway since July 1966 and will extend through 1970. A series of 10- and 20-watt fueled prototype power systems will be fabricated, assembled, and tested under actual environmental conditions to demonstrate that these have attained all performance objectives. Compatability of material, components, and design is a major objective.

The SNAP–23 project involves the development of a series of economically attractive strontium 90 power systems for remote terrestrial application. This project will result in the fabrication of 25-, 60-, and 100-watt units capable of long-term operation in surface buoys, offshore oil platforms, weather stations, and microwave repeater stations.

In regard to future needs for kilowatt systems, the AEC has become increasingly aware of the potential needs for large isotope plants for the man-in-the-sea type of activities; for offshore oil exploration; ASW systems; manned and unmanned research stations, and the like.

Our evaluations and assessments of these potential needs have resulted in AEC initiation of a research and development program directed toward the eventual development of isotope-powered systems in the 1- to 10-kilowatt range.

The first phase of this program consists of an extensive applications engineering and design study to evaluate alternate energy conversion cycles, plant configurations, isotope fuel requirements, performance requirements, environmental constraints, and, of course, economic criteria.

In the course of this study, liaison will be conducted with potential users in order to match alternate concepts with broad areas of application. The final objective of this initial effort, once the parametric, conceptual design and cost-effectiveness studies are completed, is to define and assess the technological advancements required to develop the various power systems that offer greatest promise and to determine the resources and time required to pursue this development.

There is little question that the development of an engineering capability in this high-power area will require the commitment of extensive funding on the part of the AEC. For this reason, it is considered mandatory that a very careful assessment be made at some time prior to commitment of these resources.

Specific accomplishments cannot yet be cited for nuclear reactors in oceanographic applications since this program is in its infancy. However, the AEC has provided compact nuclear reactors power sources for a variety of specialized land-based applications several of which can be expected to furnish valuable technology to the ocean engineering program.

The AEC's current plans to develop the technology for oceanographic nuclear reactors are presently being formulated. Paper studies are being conducted to assess the capabilities of appropriate reactors plants and will be followed by careful economic assessment.

As I mentioned at the outset, we think all of AEC's marine programs contribute to attainment of the Marine Council's goals. Although ours is a modest program, we think it is an important one not only toward solving problems with radioactivity of primary concern to AEC, but also in its multidisciplinary approach to understanding the real environment. Our contributions in advanced technology stand on their own merits.

We are cooperating with the Marine Council in every way possible. AEC Chairman Seaborg, as a member, has participated in the meetings of the Council. AEC has partially funded the Marine Council's data management study and has provided manpower to assist in contractor selection and review of work under that contract.

Previously, we likewise supported the interagency buoy study. AEC has nominated personnel to serve on five of the Marine Council's committees and panels which were established to review and discuss agency programs related to oceanography. These committees, for the most part, are only getting started this month. We also have arranged to review our marine programs with the National Marine Commission.

On the whole, we think the Council is doing a remarkably thorough job in stirring things up, in arousing national and international interest in marine developments, in identifying gaps in the total Federal program and in effecting interagency contacts on program areas.

Mr. Chairman, that concludes my statement.

Mr. Lennon. Thank you very much, Mr. Joseph. I quite agree with you that the Council is stirring things up.

I was pleased to note from the minutes of the National Council, which convened first on August 17, 1966, that the Chairman of the Atomic Energy Commission attended practically every meeting and had his representatives there with him.

We appreciate your interest in the ultimate relationship of your agency with the vast number of other marine technological and scientific agencies.

Gentlemen, keep in mind that we start at 11:15 with the Coast Guard—and I recognize the gentlemen from Ohio.

Mr. MOSHER. Mr. Chairman, my question obviously comes from my own profound ignorance of these subjects. Mr. Joseph, you speak at the top of page 2, of your interest in the effect of radioactivity which has been or may be released in the marine environment.

How do you compare the characteristics of the marine environment in that regard with the world's atmospheric environment.

Are they different?

Mr. JOSEPH. I think we are speaking of two different magnitudes on the rate of movement after deposition.

In our division of biology and medicine, we have a fallout studies group, which is another part of the environmental studies conducted by the AEC.

This group is concerned with the fission products ejected into the atmosphere, and later as the fallout is returned to the surface of earth.

The fallout comes to the oceans as it comes to the land surface, in proportion to their relative areas. So, the oceans covering 70 percent of the earth's surface get, roughly, 70 percent of the fallout.

Mr. MOSHER. You have to consider these two environments as a system in their interrelationships.

Mr. JOSEPH. Yes; and we work closely with the fallout studies group.

Mr. MOSHER. Does radioactivity travel much faster in the air than it does in the water?

Mr. JOSEPH. In terms of velocity, in terms of deposition, yes. Radioactivity deposited on the land surface, moves in a different way from that deposited on the sea. On land it more or less is selectively absorbed or caught on the soil materials themselves and then enters the ecosystems relatively slowly.

Once it hits the water, we think it goes into solution, quite rapidly. And this is part of our problem, to find how this material behavior changes with time—once it hits the water it almost immediately becomes incorporated as part of the chemical system, which then interacts geochemically with the sea water. It can precipitate out or it can go into a sort of a static or dynamic equilibrium with the chemicals there, and become incorporated in the organisms.

Oceanography is still in an infant stage. We are trying to study these things in a systematic way. I hope I have answered your question.

Mr. MOSHER. It is a fascinating subject, but we do lack time to discuss it further here.

Mr. KARTH. Would the gentleman yield?

Mr. MOSHER. Yes.

Mr. KARTH. Which is more dangerous, the radioactivity in the water, or in the atmosphere and soil?

Mr. JOSEPH. I don't think we have enough information to answer, but I think our interest has been focused on the land situation, because this is in closer contact to man and his daily activity.

In terms of concentration of activity in the sea, we don't think we have any dangerous situation by the fallout that has been produced so far.

Mr. KARTH. But all the land use residue is dumped in the ocean.

Mr. JOSEPH. Could I take just a minute to give a little background on the waste disposal business?

There have been weapons tests—nuclear devices testing has been by far the greatest input to atmospheric fallout. We also have nuclear powerplants. However, these are engineered situations, which do not release very much radioactivity even though fission products are also produced in the fuel elements. I made a calculation just recently trying to compare the nuclear powerplant fission product production with that of fallout, from nuclear testing.

The operating history of six powerplants over a 6- to 8-year period results in the equivalent of about 5 megatons of fission products being produced.

From nuclear testing, all countries have produced something on the order of 200 megatons, so the nuclear reactors have contributed something like 2.5 percent of the fission products in existance.

But these fission products are incorporated in fuel elements, and they are bound with some esoteric alloys like zirconium or stainless steel, which are designed to resist the erosive and corrosive forces of the cooling water.

The fuel elements then go to chemical processing plants where the fission products are separated from the unburned uranium, and the major part of the fission products go into long-term storage tanks, and Mr. Seiken here, recovers these from the tanks to use in his isotope power systems.

The direct release of waste from reactors is also under engineering control, and you can look at the summaries of history of monitoring these things and on the order of—I couldn't begin to equate this with the megatons of fission products that have been produced in nuclear explosions, but it is very small.

The same is true of the nuclear navy. The fission products are under fairly tight controls. There are all sorts of anomalies possible here, and there may be some nominal, small discharges at times.

The subject that hit the public's interest a few years ago; namely, packaged waste disposal into the oceans, has been dormant since about 1960 or 1961. The United States, per se, has done very little in the way of packaged waste disposal.

Other sources of activity coming into the marine environment are from the operation of some plants like the special materials production plant at Hanford, which have a unique kind of reactor. These were designed and developed early in the game, back in the 1940's.

They weren't looking for nuclear power then, so they were running cooling water through the reactors to keep them cool.

In this system, materials in the water become neutron activated and are carried along with the water, so some of those products are contributed to the stream and carried out to the ocean environment.

Mr. Karth. Of what interest is that?

Mr. Joseph. We have been following this closely, and the concentrations, in the Columbia River and the estuary and the offshore environment, have been well below those levels stated by the International Commission on Radiological Protection and our own National Commission on Radiation Protection—they have been a few percent of the levels that they have stated are tolerable by man without hazard.

Mr. Karth. Is that where it enters into the stream, or is that after it becomes diluted?

Mr. Joseph. I would have to say in the vicinity not too far downstream from the reactor. Of course, in the pipeline itself, it might be a little bit warmer, but I stay away from this consideration because this gets into a classified area. I don't have that kind of information at hand. I prefer to deal in the unclassified aspect.

Mr. KARTH. It is kind of important to you, I would assume.

Mr. JOSEPH. Yes, sir; it is. At the pipeline, this is in the freshwater part of the system. It doesn't come into the marine scientist area until it gets way downstream.

Mr. LENNON. Could we go off the record?

(Discussion off the record.)

Mr. ROGERS. I would like to know, and you can furnish this for the record, the portion of your budget that is oriented toward oceanography work, the number of personnel involved, and what your projections are for the activity of your agency in this field.

Also, I am anxious to know if you are doing work for the DSSV?

Mr. JOSEPH. Admiral Rickover's group is cooperating with those people.

Mr. ROGERS. Won't that be in 1970 on the second phase of SNAP-1?

Mr. JOSEPH. Yes, sir.

Mr. ROGERS. What are the prospects of speeding that up, or would that be desirable? It seems to me it could be a very vital element if we are going to do any truly deep submergence work or develop a new power system.

Mr. SEIKEN. Deep submergence nuclear power applications involve both electric power and vehicle propulsion. In regard to use of nuclear power for stationary electric power generation, we believe our programs * * * both isotope and reactor power systems development * * * are proceeding at a proper rate. In view of that fact that hard requirements are still some time away, there is no need to accelerate our efforts in order to develop a specific system by a given date. We plan to make use of this time to establish a sound base of technology which could be applied to meet specific needs with a minimum of basic research and development. Essentially, once the basic technology is established, it becomes a relatively straightforward engineering effort to apply this technology. It is this latter effort that can be easily accelerated without compromise to reliability and performance objectives.

In regard to reactor propulsion for deep-sea submersibles, AEC's activities in this area are under the direction of Admiral Rickover, Director of the Division of Naval Reactors. These program activities involve classified information and are beyond the scope of our testimony.

Mr. ROGERS. Who is keeping it from whom? The AEC is not keeping it from the Navy, are they?

Mr. SEIKEN. No, sir. This technology is being developed specifically for Navy application and under a cooperative AEC-Navy program.

Mr. ROGERS. You don't think the civilian area should have this information?

Mr. SEIKEN. It is a classified area, and I cannot deal with that.

Mr. ROGERS. I understand that. We can go into that later on.

I hope you will outline difficulties that are being encountered.

Thank you.

Mr. LENNON. The gentleman from Washington.

Mr. PELLY. Dr. Joseph, could you tell me whether under the seabed of the ocean there is uranium we might recover sometime when we need it?

Mr. JOSEPH. There certainly is, but I think in this case we have not done nearly enough exploratory work to define any deposits, or even characterize them. We have measured uranium in manganese nodules and other areas.

Mr. PELLY. If it is there, we ought to find out about it. We will need

Mr. JOSEPH. I agree. We simply cannot—do not know enough about the ocean floor to say how much is there, but I would agree——

rights to the ocean floor to the United Nations at this time because of our own need for such materials?

Mr. PELLY. Is there a scarcity of uranium now available to us in the foreseeable future so that we might be wise not to turn over any in the deep layers of the sea, so we know uranium is there.

We are increasing radium and radon in order to measure diffusion it. Is that correct?

Mr. JOSEPH. I think so.

Mr. PELLY. Thank you.

Mr. LENNON. The gentleman from Virginia for 3 minutes.

Mr. DOWNING. I have no questions.

Mr. LENNON. Mr. Keith, for 3 minutes.

Mr. KEITH. Thank you, Mr. Chairman.

I note in here that you talk about farming of the sea. Perhaps you heard some of the discussion yesterday about the possibility of zoning the seabed, particularly within the Continental Shelf, excluding further mineral exploration in an effort to have this research concentrated in areas which obviously would not be harmful to our fishing interests. I would appreciate it if you would comment on the wisdom of such a zoning proposal.

Mr. JOSEPH. In my statement, I referred to our basic food web studies, which I think are basic to many considerations, pollution, contamination, as well as controlling marine resources per se.

When it comes to zoning, we have to think, in dealing with isotopes, more in terms of a water-limited area, an embayment or a creekbed or something like this, adjoining the ocean.

Otherwise, if we are in an area where you have direct flux with the open ocean environment, you have more or less lost your control.

There are places, though which may be fenced off—I know of one experiment where a genetically developed fast-growing breed of salmon developed by Dr. Donaldson on the west coast have been put in a fjord in Norwegian waters and are apparently thriving.

But from the point of view of controlling the nutrients and other things that are necessary to sea farming, I think we have to do a lot more work toward understanding the situation before we can adopt it.

Mr. KEITH. Would you see any need for a marine resources study concerned primarily with setting aside certain areas for certain uses?

Mr. JOSEPH. I think so. It is a matter of degree. We are in that situation now, where we are more or less committing shorelines and offshore waters to new uses.

Mr. KEITH. Thank you, Mr. Chairman.

Mr. LENNON. Thank you, Mr. Keith.

The gentleman from California?

Mr. HANNA. I have no questions.

Mr. LENNON. Mr. Reinecke.

Mr. REINECKE. When do you anticipate this 10-kilowatt unit will be available?

Mr. SEIKEN. We look to a 3- to 5-year period of development, starting from this time.

Mr. REINECKE. Is it realistic to think that after that you may go to a hundred kilowatts?

Mr. SEIKEN. Yes sir, but not necessarily with isotopes. At the present time we believe isotope power to offer attractive undersea power capability at a power range of up to 10 or 20 kilowatts. Furthermore, we believe nuclear reactors are feasible and attractive at a power range as low as 100 kilowatts. In between these two limits is a gray area. In certain instances isotopes may be attractive—in others reactors. Much will depend upon the specific mission requirements.

Mr. REINECKE. Do you envision a sensing system throughout the world as a means of detecting military fallout?

Mr. JOSEPH. Indirectly. I think we can use a synoptic system now, to measure mixing systems—water masses and currents.

Mr. REINECKE. I believe you mentioned in your paper there was a concentration of cesium in the ocean—I am not sure what—but nevertheless, was this sufficiently concentrated to affect the fish?

Mr. JOSEPH. No. We have been following concentrations of cesium in various classes of marine organisms from plankton up to the higher trophic levels, and cesium doesn't concentrate in organisms to any degree. It is about a 1-to-1 concentration factor in the flesh of marine organisms.

Mr. REINECKE. I believe you mentioned there is a chemical reaction. Does this affect the half life?

Mr. JOSEPH. No. Nothing changes the half life.

Mr. LENNON. The gentleman from Alabama for 3 minutes.

Mr. EDWARDS. Thank you, Mr. Chairman.

Could you say in layman's terms that radioactivity or radioactivity fallout will wear itself out eventually in the ocean?

Mr. JOSEPH. Eventually, yes.

By radio activity decay—we use the term "half life." A given amount of radioactive substance will lose half of its activity in the period of the half life, but the half life varies with the isotope involved. And this can be anywhere from a microsecond—a millionth of a second—on up to—oh, some of the longer lifed isotopes are of the order of 10 to the 10th power years—10,000 years.

Mr. EDWARDS. That is layman's language? [Laughter.]

Mr. JOSEPH. A rule of thumb we use is that a given amount of radioactivity will decay to one-tenth of 1 percent of the original amount you started with in a period of 10 half lives.

Mr. EDWARDS. I guess what I am getting at is that over a period of years, as we get more and more involved with nuclear power and what-not, there will be more and more radioactive substances falling into the ocean.

Is it there forever? Are the fish that are in the ocean over a period of years going to become more and more saturated with radioactive material? Is this a real problem?

Mr. JOSEPH. Let me answer your question this way, if I may.

I participated in a recent expedition to Bikini to measure radioactivity in the Bikini and Eniwetok testing grounds. During the testing program about 45 devices were exploded over a period of 8 to 10 years.

The least contaminated organisms found in our expedition were the fish. They have a way of renewing their stocks. They are recharged and mixed with populations from the outside environment, that is, the environment outside the testing grounds.

Some radioactivity resides in the soils. It has decayed to fairly low levels, and is more or less cycled more slowly out of that ecosystem—that ecological environment.

In answer to your question, I think fish adapt fairly well, but I say this advisedly knowing that I don't have all the information by far.

Mr. Edwards. There is a lot more research to be done?

Mr. Joseph. Yes, sir.

Mr. Edwards. Thank you.

Mr. Hanna. Would the gentleman yield?

Is there a possibility that there are peculiar environments in which there is more susceptibility to buildup radiation conditions than in the environment of ocean as a whole?

Mr. Joseph. Only if there are some unusual physical or chemical characteristics of this system which will tend to selectively pull out the radioactivity.

Unless there is something peculiar about the environment, probably not.

In some cases where there is a lack of a normally available trace substance, organisms adapt to it. And then if you provide a contaminant which they could use, they can build it up to quite high concentrations.

We are looking for these anomalies as part of our program.

Mr. Hanna. Thank you.

Mr. Lennon. Off the record.

(Discussion off the record.)

Mr. Lennon. May I have one question?

On page 3 you say:

> AEC contractors have made significant contributions over the past several years by way of developing instruments and techniques for identifying and measuring nutrient cycles and trace substances necessary to life in the sea—also to distinguish living from non-living organic substances.

This is what I wanted to ask you about:

> An automatic analyzer system has been developed to determine nitrates, phosphates, silicates and chlorophyll automatically and continuously on shipboard while the vessel is underway.

Now, do I understand that instruments have been developed which will permit the identification of phosphate, silicate, or chlorophyll while the ship is in process of moving over the seas bed. That is what you state here on page 3?

Mr. Joseph. Yes, sir. Let me add to that statement a little bit to clarify it—I hope.

Water is taken right near the surface of the sea. There is no reason why we couldn't put a pipeline on the ship to go deeper and measure in profile. Of course, the deeper you go while the ship is underway, the more mechanical problems you have with the pipeline per se.

But the water is pumped through a technicon autoanalyzer. It was a device developed in the medical industry for measuring specific substances. It mixes the chemical reagents to the sample while it is passing through the instrument. And by measuring changes in color or gravametric precipitates caused by the reagents, you can determine a particular constituent in which you are interested.

Mr. Lennon. You can determine precisely whether it is phosphate or nitrate and precisely where that bed is?

Mr. Joseph. No, sir, it is not used as a geological survey tool. It is used for measuring these things in solution in the water. These are the nutrient elements used by the organisms.

Mr. Lennon. You go on to say that this would describe the patchy distribution of plankton in the sea.

Mr. Joseph. Yes, sir.

Mr. Lennon. That will conclude the hearing on this phase this morning.

If you have additional questions, you must submit them to counsel in any length you like, related to the subject matter of the witness' testimony, which he will be asked to respond to and send back to the counsel within a reasonable period of time.

Thank you, gentlemen.

It is necessary for us to move on and hear another group.

We are happy to have today Adm. W. J. Smith, the Commandant of the Coast Guard. He is representing the Department of Transportation along with his advisers from the Coast Guard.

We welcome you here, gentlemen, because this parent committee, the Merchant Marine Committee, has a subcommittee on the Coast Guard, which some of you gentlemen serve on.

Come forward, please, Admiral Smith.

It might be well to have your staff sit on the front row so that you might confer with them.

After your statement, we will determine the time to be used by the several members of the committee for interrogation.

I assume that each member of the committee has in front of him a copy of the admiral's statement.

Admiral Smith, are you going to follow the statement, sir?

Admiral Smith. Yes, I plan to follow the statement.

Mr. Lennon. Thank you. You may proceed at this point.

STATEMENT OF ADM. W. J. SMITH, COMMANDANT, U.S. COAST GUARD, DEPARTMENT OF TRANSPORTATION; ACCOMPANIED BY CAPT. PETER S. BRANSON, CAPT. WILLIAM A. JENKINS, AND STAFF

Admiral Smith. Mr. Chairman and members of the committee, I am pleased to have the opportunity to appear before you today and report on the status of the Coast Guard participation in the Federal marine sciences effort.

I wish to state that the Secretary of Transportation recognizes the Coast Guard's capability, resources, and programs in this field. He fully supports our ongoing direct input in this very major area of national interest.

I believe it is fair to say that, by virtue of the basic structure of the Coast Guard, an organization of ships, planes, stations, and trained maritime personnel, a potential is inherent for a major contribution to any national coordinated effort in the marine sciences field.

All of the Coast Guard's missions support the national marine sciences program. In the narrower field of oceanography, our mission is to provide data and research in support of responsibilities for safety of life at sea, and to furnish oceanographic services to other agencies in furtherance of the national program.

The authority for this work comes from 46 U.S.C. 738, requiring the Coast Guard to conduct international ice patrol, and from 14 U.S.C. 94, which states that "the Coast Guard shall conduct such oceanographic research . . . as may be in the national interest."

The Coast Guard has supported marine science projects since its inception. Since 1914 an active oceanographic program has been carried out for the international ice patrol. This program has resulted in several "firsts" in oceanography, and has given the service a depth of experience in the field.

The combination of over 40,000 personnel, 325 ships, 160 aircraft, and 750 shore stations makes the Coast Guard uniquely qualified to provide support to the national program on a cost-effective basis.

The Coast Guard has 35 ocean station vessels and eight icebreakers equipped for oceanographic research in conjunction with their other missions. In addition, there are two research ships devoted exclusively to oceanographic missions.

The Coast Guard Oceanographic Unit located in the Washington Navy Yard quality controls all data and conducts research on projects pertinent to Coast Guard missions.

The Coast Guard operates an oceanographic technician course at Governors Island, N.Y. This course is believed to be unique within the Federal Government and is available to personnel from other agencies.

We send officers annually to universities for postgraduate study leadiing to degrees in oceanography. In addition, we are sending two officers for postgraduate training in ocean engineering this fiscal year.

Cadets at the Coast Guard Academy receive a one-term course in oceanography and meteorology during their second year. They also may take an elective course during their senior year involving advanced study and the writing of a thesis in the marine sciences field.

Dr. Richard Fleming, director of oceanography at the University of Washington, is a member of the Academy Advisory Board. The Advisory Board has recommended increased curriculum emphasis in the marine sciences field. Dr. Fleming's enthusiasm and interest have been extremely helpful.

We are cognizant of the growing interest in the marine sciences taking place on college campuses. We believe that a better appreciation of the academic areas of oceanography and ocean engineering would be realized by the student if he were exposed to seagoing operations early in his academic career.

In this connection, the Coast Guard would be pleased to provide space aboard its ships in order that students may have this early indoctrination to the seas. In particular, introduction to oceanographic equipment and the handling of heavy weights aboard ship should prove particularly valuable.

A substantial portion of Coast Guard personnel, both military and civilian, are engaged in work directly related to the marine sciences program. Engineers of the various disciplines, merchant marine safety experts, and personnel in the aids to navigation field are representative. Many of these people have received postgraduate or other special training.

One of the major data collection programs takes place on the four Atlantic and two Pacific ocean weather stations manned by Coast Guard cutters. The oceanographic data obtained is particularly valuable in that it is collected repetitively both in time and location.

This data is used in ice patrol research, weather, and antisubmarine warfare prediction, and by the Bureau of Commercial Fisheries for marine life studies.

A similar program carried out by cutters en route to ocean stations obtains time-series data from tracks selected because they cross ocean features of significance.

Our international ice patrol program has developed survey methods which quickly produce synoptic-current charts for ice drift prediction. The conductivity bridge for salinity determinations and shipboard computers for rapid data processing at sea were first used aboard the ice patrol oceanographic ship.

Our many years of experience in the Grand Banks area has permitted the construction of charts of standard dynamic topography. These charts permit more rapid synoptic surveys and better operational information during each ice season.

Improved operating methods have paralleled technological advances. As a result, ice patrol operations which were first carried out by a force of cutters are now conducted by a single oceanographic ship and a long-range aircraft equipped with advanced detection equipment for discriminating ice from other targets through the fog and undercast so prevalent in the Grand Banks.

During the past year the transfer of polar icebreakers from the Navy was completed. The Coast Guard now operates the entire fleet of eight ships. Seven of these ships, the *Wind* class, were built in the mid-1940's. *Glacier* was completed in 1955.

In conjunction with their other duties, the ships carry out oceanographic programs for the National Science Foundation, the Navy, and academic institutions. They also support national transportation needs in the coastal United States when their icebreaking services are required in support of domestic commerce.

On the Continental Shelf of the United States, lightships are being replaced with fixed towers. These towers, the only Federal network in the coastal area, are excellent platforms for the description of the environment and conduct of air-sea interaction research.

The present facilities include a laboratory, and we are proceeding with a plan to install automatic sensor systems on each tower. A prototype system was installed last winter at Buzzards Bay Entrance Light Station. Follow-on systems are under consideration.

Coast Guard aircraft make regular flights over the continental shelves of both U.S. coasts measuring sea surface temperatures by infrared radiation thermometers, in a project conceived by the Bureau of Sport Fisheries and Wildlife. The data is used in predicting marine life migrations.

Several international cooperative oceanographic investigations have been aided by the Coast Guard. Currently, cutters are participating in the study of the eastern tropical Pacific, the cooperative study of the Kuroshio, and investigations on Georges Banks (off Cape Cod) for the International Commission for the Northwest Atlantic Fisheries.

In addition to the large programs described, the Coast Guard cooperates with other agencies in over 40 projects. These involve many

Coast Guard resources and cover a wide range of activities, such as oceanographic and meteorological data reporting, marine studies, geophysical surveys, and submersible handling.

The Coast Guard is managing a study of the feasibility of a national data buoy system under the auspices of the Marine Sciences Council. The study will compile and analyze maritime oceanographic and meteorological data requirements, survey the state of the art in data-buoy systems, conduct a cost-utility analysis to determine which data can most economically be obtained by buoy systems and which systems have the best promise for cost-effective acquisition of data, conduct a cost-benefit essay to determine whether buoy systems are in the national interest, and, finally, develop a step-by-step plan for the research, development, and implementation of a national system.

The Marine Sciences Council is conducting reviews of the data-buoy program.

A large navigation buoy has been placed in the approaches to New York Harbor at the location of the old Scotland Lightship. Next month we will install a prototype sensor system which will collect surface meteorological and oceanographic data.

The buoy's telemetering capability will be used to transmit this information to a shore control station for direct relay to users, such as ESSA. Future similar lightship replacements will be instrumented.

The Coast Guard's resources in buoy tenders and experienced buoy personnel are being used to good advantage in servicing oceanographic buoys for other agencies.

One buoy tender is now devoting full time to this task. Others are expected to be available in the future as increased effectiveness in the aids to navigation system, generally through the use of more reliable equipment and power sources, reduces the system demand for ship services.

An oceanographic research ship is included in our 1968 budget request for ship construction. This ship will replace the 24-year-old converted buoy tender *Evergreen*, which works full time on ice patrol and other national programs.

The new ship will have advanced capabilities to be completely responsive to multidiscipline national programs. The ship is supported by the full Committee on Merchant Marine and Fisheries and by the Marine Sciences Council.

An icebreaker replacement study is underway. The Department of Defense and the Marine Sciences Council have been asked for their views on the military and scientific deep-polar needs, respectively, for these ships. With this input we will complete a cost-effectiveness study to determine the optimum composition of the icebreaker fleet, both as to size and propulsion plants.

We are procuring 20 loran–C and four Navy navigation satellite receivers this year for improved positioning accuracy necessary for oceanographic investigations.

Participation in the Spacecraft Advisory Committee on Oceanography and the use of satellite sensors for ice detection have given new promise for increasing the efficiency of international ice patrol.

With the increased emphasis on oceanography and related matters, a Marine Sciences Division was established last year with our administrative organization. An Office of Research and Development is also planned to support mission responsibilities of the Coast Guard with special emphasis in the marine sciences field.

Legislation is under study to permit the coast Guard to inspect and certify underseas structures which present a potential danger to life and safety at sea, as well as being a pollution hazard.

In a parallel program, techniques for underwater search and rescue are being investigated as the use of nonmilitary submersibles increases.

Legislation which will give the Coast Guard authority to inspect and certify these small underseas craft not presently subject to regulation is also under consideration.

Additionally, a national navigation plan is being formulated within the Department of Transportation by the Coast Guard and the Federal Aviation Administration. This plan is expected to be responsive, within the national interest, to the needs of all users. No similar integrated plan has previously existed.

This effort offers the potential of eventually providing on a cost-effective basis the precise navigational information needed in carrying out oceanographic programs in the national interest.

In summation, an analysis of the Coast Guard program shows that our total effort is in direct support of national programs. It is a user-oriented program that is a logical extension of the other Coast Guard missions involving services to maritime interests.

Coast Guard missions reach on, over, and within the seas. They are interrelated. They often use the same facilities for cost-effective operations. And they use common support systems.

The complementing marine science activities are similarly interwoven.

The Coast Guard by reason of cost-effectiveness on a systems basis and quality of data provided is, with its professional seagoing capability, well equipped to develop, construct, operate, maintain, and service oceanographic platforms—be they ships, aircraft, or buoys.

Such programs can be totally responsible to agencies generating the basic requirements, as are the existing programs.

We welcome the emphasis placed on increased direction of the national marine sciences program. We have been and will continue to utilize our marine sciences capability, and, as the maritime arm of the Department of Transportation, will work with the Administration and the Congress to insure that the Coast Guard's capabilities are fully utilized in the national interest.

Mr. LENNON. Thank you, Admiral.

Off the record.

(Discussion off the record.)

Mr. LENNON. Back on the record.

Thank you, Admiral Smith, for a very fine statement. Let me commend you, because the record reflects that since the formation of the National Council, headed by the Vice President on August 17 last year—the record reflects, I am almost sure that I recall it, that you have attended each of the monthly meetings since the formation of the National Council on August 17, 1966.

You may have missed one, but I didn't read about it.

But I have checked those attendance records to see who attended these meetings, and I am very gratified by the level of people who attend. They are scientific advisers, the secretary of this, that, or the other.

Interest and concern is being shown.

Let me commend the Coast Guard, too, for something I have so long hoped for, and that was the proper, deserving acknowledgment of the Coast Guard.

I think the two issues of Life magazine graphically depicted the missions and roles of the Coast Guard. I don't know who your public relations officer is now, Admiral Smith, but I congratulate him. He has finally succeeded in getting the public recognition of the Coast Guard that I have been trying so hard to get. The Coast Guard rightly deserves it.

I think the pictures are true to life and depict the hazards to which the Coast Guard is subjected. I have an idea that a lot of these pictures will be framed and put on the wall of homes of interested Americans.

Mr. PELLY. I would like to commend the admiral for the work of the Coast Guard in protecting our marine resources. I refer particularly to your apprehension of Russian and Japanese fishing vessels in our waters.

As I have indicated before, I hope you will continue to utilize your great organization to protect what we now have, as well as to discover what we may harvest from the ocean.

I certainly wish you had sufficient cutters and, also, encouragement from the administration to go down and protect our fishing boats which are being illegally seized on the high seas and fined by certain South American countries.

I share the chairman's feeling of enthusiasm for your very fine organization.

Admiral SMITH. Thank you, Mr. Pelly. The Coast Guard will continue our enforcement on the east and west coasts and in Alaska of our laws.

It is true that we have not proceeded in southhern waters for this same purpose for reasons with which I am sure you are fully familiar.

Mr. PELLY. The reason given to me is that it is not our policy to meet force with force. But I think if we had a cutter down there, we wouldn't have these seizures and harassments. All we would have to do is show a little force.

It is unthinkable to me as an American that when a ship flies the American flag, she doesn't have protection on the high seas.

Mr. LENNON. The gentleman from Virginia.

Mr. DOWNING. I have no questions. I would like to compliment the admiral.

Mr. REINECKE. I would like to compliment the admiral, particularly on the overwhelming cooperative attitude of the Coast Guard that it takes toward other agencies interested in oceanographic work.

This has been pretty lacking in the case of many other agencies which have opened their programs. We are deeply grateful for this.

Thank you.

Mr. LENNON. The gentleman from California.

Mr. HANNA. I would like to have the admiral expand on two phrases that interested me in his speech.

One of them, I think, refers to what the gentleman from California, Mr. Reinecke, was speaking about. He used the phrase "user oriented."

The other phrase that I would like to have you clarify is the phrase "cost effectiveness on a systems basis."

Admiral SMITH. Where was the "user oriented"? I just want to check the context.

Mr. HANNA. Near the end of your statement, on the next to last page or the last page.

Mr. DREWRY. Page 8.

Mr. LENNON. It is on the second line of paragraph 4 on page 8.

Mr. HANNA. We are "user oriented," you say.

Admiral SMITH. What I mean, Mr. Hanna, is that, while the Coast Guard is heavily involved in the marine sciences field, the information we collect is largely used by agencies other than ourselves. As I have stated, under the requirements of 14 U.S.C. 94, we have an important responsibility for oceanographic research. We accomplish this, not only directly through our oceanographic vessel activities but also in connection with our other operations, such as our ocean station program, polar icebreaking, our offshore stations, our coastal stations, and special aircraft flights. We do use oceanographic data for iceberg prediction and for search and rescue drift prediction; additionally, a significant amount of data is furnished the National Oceanographic Data Center for use by the Navy, ESSA, Bureau of Commercial Fisheries, and other scientific programs.

When I speak of the "cost effectiveness" and the "systems approach," what I am saying is that I think the ocean station vessel program is perhaps the best example of this.

We have these vessels proceeding to and from stations, and on stations for reasons outside the marine sciences and oceanography field as such.

The fact that they can, in addition to performing their duties as ocean station vessels, accumulate this information, we feel is cost effective from the standpoint that if this data is important and necessary, that if we weren't able to do it with these ships, somebody else would have to provide another ship to do this type of work.

Mr. HANNA. In other words, what you are saying is that you have a multipurpose use that is available far beyond the scope of the limited mission?

Admiral SMITH. Yes, sir, that is correct.

Mr. HANNA. Thank you, Mr. Chairman.

Mr. LENNON. The gentleman from Alabama.

Mr. EDWARDS. Admiral, I want to echo what the others say about the Coast Guard.

I think that this whole committee feels very strongly that the Coast Guard is serving a great purpose and handles itself with great distinction.

I am interested in your comments on what you might call a "byproduct" of your normal duties.

You mention, on page 5 of your statement, just what you were talking about, that in conjunction with your other duties you carry out oceanographic programs for other institutions.

Who determines which projects you will carry out in addition to your normal duties?

Admiral SMITH. The requirements for oceanographic data are generated, of course, by a number of different Federal agencies and, also, scientific institutions.

Up until very recently, the final approval and coordination of programs were handled by the Interagency Committee on Oceanography.

This is now handled in the National Council, which reviews these programs and decides which ones should be accomplished.

Then the agency, if it has the capability and equipment, is assigned to carry out this mission.

Mr. Edwards. So that assuming an academic institution working on a research project thinks the Coast Guard could be of assistance, they would go to the National Council and present their program. And the National Council would, in turn, say to the Coast Guard: "We think this is a legitimate project you can carry out." Is that true?

Admiral Smith. Yes; this is true of larger projects. For smaller projects that are of a localized nature, we may respond without clearing all the way through the Council.

Mr. Edwards. I guess I am getting at this: Does the Coast Guard, in effect, have the authority to say to one of these agencies: "We are just not going to do it, or can't do it?" Or does someone outside the Coast Guard direct you to do it?

Perhaps it is not that harsh, but I would like your answer on it.

Admiral Smith. No, sir, it is not that harsh. Whether we can accomplish these things partly depends on the capability of our equipment. Do we have equipment that can do the type of project? And then are the facilities available to engage in the project?

So it does not necessarily involve a directive or a hard order. These are in line with the search for facilities that are available to perform these functions, and whatever agency can contribute is the one that will go ahead with the program.

Mr. Edwards. We are going back, then, generally to the very good cooperation between the agencies in working with each other in an effort to solve all the oceanographic problems.

Admiral Smith. Yes, sir, I would say this is the basis of it. Much of it is a cooperative program under present conditions.

Mr. Edwards. Do you look to the Council as the lead agency, more or less, in spearheading this program?

Admiral Smith. Since the Council has been in existence, we look to the Council for the leadership in establishing the national goals and objectives. And I think this is exactly the way they are going.

We have been working with them with respect to their various committee structures, with respect to furnishing them with a great variety of information which we are able to produce.

We have been working very closely with the Council staff with respect to their whole program.

Mr. Edwards. Thank you, Mr. Chairman.

Mr. Lennon. The gentleman from Delaware.

Mr. Roth. There has been considerable discussion in the past about the need of technicians to fulfill the oceanography missions of the future. I was especially interested in your statement about your course at Governors Island, N.Y.

I wonder if you could amplify your remarks, giving us some idea as to the length and nature of the program, what background students at this school are required to have.

Admiral Smith. I might say that that course we have established is essentially to qualify our own personnel for specific tasks.

I would like to ask Captain Branson, who is our oceanographer, to give you details on the course, its length, scope, and so forth.

Captain Branson. The course is an 8-week course, sir. The level of training that our personnel receive before they go to this school—they are enlisted men, who are third-class sonarmen or aerographer's mates.

They have had a fair amount of technical training before they go to this school. They do have a mathematical background.

In the school, they are taught the techniques of data processing at sea, use of the equipment, reduction of data, and actually make a cruise on the Coast Guard oceanographic ship for practical experience.

Mr. Roth. Is this a type of course that would have general application outside the Coast Guard or is it so specialized——

Captain Branson. No, sir; I think it would have general application in many places where people need oceanographic technicians—academic as well as governmental.

We have had applications from other agencies to send people to this school, and have done this in the past.

Mr. Roth. One more question in this area: Would the background and type of course be available to private institutions of learning?

Captain Branson. Do you mean, would we take in people from private institutions?

Mr. Roth. Either take them in or have people come and inspect your program.

Captain Branson. They could certainly inspect it, and I would suspect that with special arrangements we might even put them through the course.

Mr. Roth. One other question.

On page 3, the admiral said that the Coast Guard would be glad to provide space aboard the ships so the student could have experience with the sea.

If the college were interested, who would they contact?

Captain Branson. They would contact the Coast Guard Headquarters, sir.

Mr. Lennon. Thank you, Mr. Roth.

I am familiar with the course in oceanography and meteorology at the Coast Guard Academy. And I was very much impressed with your statement, Admiral, that the gentleman from Delaware has just mentioned, when you say in this connection the Coast Guard would be pleased to provide space aboard a ship in order that students may have an early indoctrination to the sea.

May I make a suggestion for what it is worth?

There must be at least, oh, I would say conservatively, 35 to 50 colleges or technical institutions throughout the country which offer courses in marine science and technology.

That list of those colleges and technical schools could be easily compiled.

I would suggest that if you gentlemen really mean what you say here, and can accommodate such a situation as having on board the Coast Guard vessels these young students at a certain age level and a certain class-advancement level—say, in their third year or senior year—that you get the list of these technical institutions which are related to the marine sciences—and colleges and universities—and send them a brochure.

We had testimony here a few days ago from Dr. Statton, who, as you gentlemen know, is Chairman of the Presidential Commission under the Marine Science and Technology Act—and, more specifically, from Dr. Geyer, who is the Vice Chairman of the Presidential Commission and, as you gentlemen know, is president of Texas A. & M. He was asked a question as to what annual input or what annual need there was for young men trained in the basic marine sciences and technology—and I don't mean at the top level, the professor level and the doctorate level.

He stated that in his judgment there was a need for at least 3,000. There was a demand for at least 3,000 on an annual basis of people moving into this field.

I happen to know of two schools in North Carolina—one being Duke University, which has been in this field for quite some time.

Incidentally, the President of the National Science Foundation is the head of this particular adjunct of Duke University. And they have their own training vessel.

I have in my hometown the Cape Fear Technical Institute, which has their own vessel. Incidentally the Environmental Science Services Administration vessel *Oceanographer*, which was commissioned here by the president selected two young men from this school as technicians.

Exploring what you said a little further, Admiral, it occurred to me that in the light of the Presidential Commission having found there was a need for a minimum of 3000 of these young people and knowing that there are approximately 35 to 50 schools in America which are interested in this field and would train people and yet do not have vessels of their own—like Duke University has or the Cape Fear Technical Institute in my hometown—it might be helpful if a brochure was prepared by the Coast Guard—the time element is not too important—of the factual proposition that you could offer.

That would have a two-fold effect. You find a lot of these young men who have gone into these so-called junior colleges or technical institutes who might become applicants because of the interest to go on to the Coast Guard Academy.

I have for a long time been interested in spreading the image of the Coast Guard across all our 50 States and not just in certain special areas. I think we are moving in that direction.

I am very pleased with the wide spectrum of applications we have had from all over the United States for entrance into the Coast Guard Academy—and the acceptances into the Academy from so many States which had not heretofore had substantial participation in the Coast Guard.

This is another way we could help the Coast Guard: Send it to the news media if you get out such a brochure. Let us make as much mileage as we can for the Coast Guard.

Are there any other questions gentlemen?

Mr. Keith. In prior testimony before this subcommittee, Dr. Richard Geyer, of the Commission on Marine Science, stated there is a serious shortage of oceanographic technicians. I join my colleagues in expressing concern about this situation.

What would be the Coast Guard's position on a proposal to greatly expand the facilities of its oceanographic technician course so that non-Coast Guard personnel would be able to participate more extensively in the course until that time when other facilities are developed to train oceanographic technicians?

Admiral SMITH. Mr. Keith, we would completely support a program to expand the facilities of our oceanography school to train non-Coast Guard personnel. It is difficult to make a positive commitment concerning the magnitude of the expansion but I feel that we could undertake early next calendar year a program to train that type of student. As an estimate I would say that with 3 months' notice and additional reimbursable funding provided by the sponsoring group to cover increased expenses, we could embark on a program to double the output of our present level of 80 per year to a level of 160. One problem would be providing the ship time which is a part of the course and this would require further study.

Mr. LENNON. Mr. Rogers, do you have any questions?

Mr. ROGERS. Thank you, Mr. Chairman.

Admiral, I am sorry I was a little late because of another committee.

What is your present activity in inspecting and certifying undersea structures for safety?

Admiral SMITH. We have been working with our offshore oil industry since just about its very beginning.

And when you speak of "undersea structures," of course, there are no undersea structures as such now. The main structure is above the sea, but it is resting on the sea bed.

Under the Continental Shelf Lands Act, we have the responsibility for assuring some of the safety conditions on these rigs. This regards, primarily, safety of navigation, what type of lights they shall display, what type of fog signals, what type of firefighting equipment, and what type of equipment for escape from the rig——

Mr. ROGERS. You are presently doing this now on all oil rigs?

Admiral SMITH. On all that are manned, yes.

Mr. ROGERS. What about the unmanned ones?

Admiral SMITH. Some of these don't obtain, but the lights and signals do pertain——

Mr. ROGERS. What are your present activities in inspecting and certifying undersea, nonmilitary submersibles?

Admiral SMITH. We have looked at the marine inspection laws, and we are convinced that the submersible, when it reaches the tonnages that the laws apply to, do come under the present laws.

But there is quite a gap in here as far as the small submersible is concerned, because the marine inspection laws do not apply to vessels of this very small tonnage. And this is the reason we are providing legislation to provide this responsibility.

Mr. ROGERS. When will that be presented?

Admiral SMITH. It has been drafted, and I believe it has just cleared the Department—or it is in the Bureau of the Budget.

Mr. ROGERS. I recall discussing with you the need to go ahead and take some action in this field about a year ago. We now have many smaller submersibles built, yet there is no agency giving a certification of safety.

Admiral SMITH. As a practical matter, there is, Mr. Rogers, because practically all of these are being built under the general guidance of the Navy, and they are being built to carry out projects or contracts in the oceanographic field that are under some type of Federal contract.

So, for practical purposes, the Navy has been supervising the basic safety requirements of these exploratory vessels.

We have been working with the Navy. We have assigned officers to their technical staffs to accumulate the knowledge and experience and know-how that we would need to gradually enter this field.

We feel now that with the upcoming development in both the recreational submersible—which we see on the horizon now—and with greater numbers of exploratory and commercial-type vehicles, that we will have to be prepared to deal with this problem.

Mr. Rogers. I think it would be urgent to go ahead and formulate regulations before we have some tragedy.

Let me ask you another question: Your responsibility is rescue work?

Admiral Smith. Yes, sir; that is one——

Mr. Rogers. What is your capability for rescue work on submersibles?

Admiral Smith. Our present capability is very limited.

Mr. Rogers. Do you have any rescue vessels?

Admiral Smith. We have some vessels that could assist in this type of work—some of our tenders, some of our rescue tugs. These are surface craft. We have no submersibles.

Mr. Rogers. None at all? Shouldn't you have some?

Admiral Smith. This is a thing that we have under consideration now. I think the day may come when the Coast Guard will have a requirement to actually own and operate submersible craft.

Mr. Rogers. How are we going to rescue them if you can't get to them?

Admiral Smith. On the Continental Shelf, some of this can be done by divers, and so forth. But the submersible is the final answer.

Mr. Rogers. Has any proposal been made that you begin to acquire capability in this area?

Admiral Smith. No proposal has been made as yet, Mr. Rogers, but we have this under consideration.

Mr. Rogers. I know I would be personally interested in following this, and I would like to see what proposals the Coast Guard makes.

I think this should be activated and movement made in this area immediately. We have many of these vessels starting to be manufactured now. I would think it would be necessary for us to have this capability in the Coast Guard, along with the inspection and certification for safety.

I would hope the Coast Guard will initiate something immediately to get this going.

I would like to ask you this: Was it your vessels that were stopped by Russia from making their oceanographic tour around the North Pole?

Admiral Smith. We had two icebreakers that were making a circumnavigation of the Pole, and they weren't stopped—that is, literally—by force, but we did turn them back, because we received information that the Russians would resist our passage through the strait that we found we would have to transit to get through this particular part of the ocean.

Mr. Rogers. How far out did you have to go from land to get through? What is the farthest point out you could be?

Admiral Smith. You mean off the coast at that point?

Mr. Rogers. Yes.

Admiral Smith. There is a great peninsula that extends off the coast of Siberia at this point of difficulty, and our vessels were scheduled and wanted to go across the top of this peninsula in the open ocean.

They made two tries to make this passage. The ice was so heavy that they had to turn back, and then we proposed to make the passage between these straits, which were between islands off the Siberian coast. And this is where we ran into the difficulty.

Mr. Rogers. What I wanted to know was, what was the farthest point from land you could pass in the strait?

Admiral Smith. About 11 miles from the land, if you passed right through the middle of it.

Mr. Rogers. As I recall, Russian vessels pass within 11 miles of the coast of Florida. Have you taken any like action to prevent their passage off the straits of Florida?

Admiral Smith. No, sir; we have not.

Mr. Rogers. Why haven't we had a reciprocal action there?

If they are going to stop us, I don't see why we couldn't stop them. Isn't it within the jurisdiction of the Coast Guard to either permit free passage or not?

Admiral Smith. I think our basic national philosophy here, Mr. Rogers, is that the right of innocent passage will be permitted provided the vessels stay outside of our territorial waters. And, of course, this is what we would like to see——

Mr. Rogers. They have even been within our territorial waters. We have them in Florida.

But the Russians won't let us have that reciprocity. Is that true?

Admiral Smith. In this area, they made exceptions in that case. I don't know under other conditions whether they would——

Mr. Rogers. Who made the decision that we wouldn't press it, then? Was this a Coast Guard decision—or State? I suspect State. Was it?

Admiral Smith. State advised against continuation of passage.

Mr. Rogers. I thought so. I think maybe we can do something to see if State can't review this, particularly in regard to the fact that they are allowing free passage right in territorial waters of the United States by Russian boats.

They have certainly been off Florida, and we have had great discussions on this. We have followed them through. But I think we have become lax on even this. I think we ought to tighten this up.

If we put pressure there, maybe they will reciprocate.

I realize this isn't a basic Coast Guard decision—it was State. But it is upsetting to me that State turns over and says: "No, we don't do it."

I hope you will press a little, put your own ships out, and take a little unilateral action—and kick them out of our territorial waters.

Mr. Reinecke. Would the gentleman yield?

Mr. Rogers. Yes.

Mr. Reinecke. I would like to know what the Coast Guard's definition is of the "territorial sea" as a result of the Geneva conference.

I have been reading the Commission report here, and it is so vague to me that I frankly admit that I can't read it and really know—and I wonder what you people feel—what is meant by the "territorial sea" and, also, the "contiguous zone," these two concepts.

Admiral Smith. Well, the "territorial sea"—and I am going to ask Captain Jenkins to be sure I am on the right track here—we interpret it still as a "3-mile limit."

The "contiguous zone" is the area of the next 9 miles beyond that under the definitions we are using now, under our own laws. And I think this is the general understanding we have.

Mr. ROGERS. For fishing rights, isn't it 9 miles beyond the 3 miles? Isn't that our law?

Captain JENKINS. Yes, sir; that is correct. The 9-mile contiguous zone is—the territorial sea measured from the base line out to 3 miles, in all cases I understand—the base line has not been definitely established, so this makes it a little difficult in certain geographic locations to actually determine the extent of it.

Mr. ROGERS. Let me ask you this quickly: How many ships have gone to Vietnam—and you can furnish this for the record—and how many have been replaced? And what is your capability in this area of oceanography?

Admiral SMITH. We have 26 patrol boats and five of our larger cutters in Vietnam now.

The loss of the larger cutters certainly reduces some of our potential to contribute in the oceanographic program.

Mr. ROGERS. Have any of those been replaced as yet?

Admiral SMITH. No, sir; they have not been replaced.

Mr. ROGERS. From what I have seen, too, the boating activities of the American people has increased rather than declined; hasn't it?

Admiral SMITH. The recreational boating activity? Yes, sir; this is increasing every year.

Mr. ROGERS. Thank you, Mr. Chairman.

Mr. LENNON. Admiral, on page 6 of your statement, you said:

> In addition to the large programs described, the Coast Guard cooperates with other agencies in over 40 projects.

I think it would be helpful to the committee, and in any subsequent use of the printed record of this hearing, if you would be kind enough to supply us with the specific agencies and the specific projects that are included in this total of 40, for the record.

Admiral SMITH. Thank you, Mr. Chairman. We would be very pleased to do that. As a matter of fact, I think there will be more than 40. I think "40" is a very conservative number, if we get down into projects——

Mr. LENNON. If you could furnish for the record, as part of your testimony at the request of the committee—then it will indicate you are furnishing it for the record at a request of the committee—the agencies and the projects on which you cooperate with those agencies, I think it would be very illuminating to those who might hereafter read the record.

(The material mentioned appears at the conclusion of Admiral Smith's testimony.)

Mr. LENNON. I yield to my good friend, the counsel, and I will come back.

Mr. DREWRY. On page 8 you say:

> Legislation is under study to permit the Coast Guard to inspect and certify underseas structures which present a potential danger to life and safety at sea, as well as being a pollution hazard.

Could you elaborate a little on what specific types of problems you have in mind?

Admiral SMITH. At the present time, the structures that we are speaking to specifically here—and there may be other types developed in the future—we are talking about structures that are being used in the offshore industry.

They come in various and different styles. Some of them are floating structures that have telescoping legs that go down and fix the structure on the bottom of the sea. And some of them are fixed permanently in the bottom of the sea.

Although we do have some responsibility now for establishing some of the safety requirements with respect to aids to navigation or firefighting or escape from the rig, we can see as these develop in complexity that there will have to be further safety requirements established with respect to their inherent strength and stability, and so forth.

The American Bureau of Shipping is working with the industry in this respect to establish certain standards that they would maintain for them.

We have been looking to the industry to take the leadership in setting standards for their rigs that are safe in the environment they operate in. And they have done a very good job.

We have been quite satisfied with this.

But as these rigs get more complex and as we get more of them scattered on various parts of our coast, I think they are going to have to be looked at more carefully. And we are looking at them now.

Mr. DREWRY. Are they primarily in the petroleum industry now?

Admiral SMITH. They are in the petroleum and gas industry. But I am sure there will be other kinds of mining developments that will come along on the Continental Shelf and other places that may finally result in the construction of rigs right on the ocean floors, rather than have them protrude above the ocean.

So we are looking ahead to establish safety standards.

Mr. DREWRY. You are not actually drafting legislation at the present time; are you?

Admiral SMITH. Yes, sir; we are drafting some, and we are presently discussing it with our Department.

Mr. DREWRY. What is the present status of the research vessel law that we passed here 2 or 3 years ago, the one to set up special safety standards for a vessel used for research activities as contrasted with, say, a fishing boat, where the six-passenger-for-hire limitation comes in?

Admiral SMITH. We are just about coming to final grips with the writing of the regulations.

You are speaking now of the oceanographic ships?

Mr. DREWRY. That is right.

Admiral SMITH. We have had real problems in connection with the preparation of these regulations. We have had very comprehensive and long and detailed meetings with various segments of the oceanographic community—the people who are interested in operating the ships. And we think now that we have got some regulations that they can live with and that we feel will carry out the intent of the legislation.

Mr. DREWRY. Do they think they can live with it?

Admiral SMITH. I believe they do now, Mr. Drewry.

Mr. DREWRY. The chairman just mentioned that there have been some complaints, some complaints that perhaps the regulations have been, as you characterized the meetings, "comprehensive, long and detailed." And I am just wondering what the present status is.

Admiral SMITH. I think that one of our principal problems in the regulations has been in the manning area. And I know this is one of the real problems some of the organizations have that operate the vessels.

On the other hand, the laws are quite clear here, so that we haven't been able to succeed with all the things they would like to be able to do with respect to the qualifications of the personnel and the benefits that are accrued to the merchant marine personnel under the law.

I think we have done some of the things that we—they were concerned about the status of the scientists and engineers aboard the ships. But ships of certain tonnages and certain characteristics, under our laws, will require manning by people who have been licensed and certificated as competent to go to sea.

Mr. DREWRY. Thank you, Mr. Chairman.

Mr. LENNON. Admiral, can you perceive that any time in the projected future there is the possibility of the construction on the ocean bed beyond the Continental Shelf of undersea structures that could become ultimately a potential danger to either life or safety?

Admiral SMITH. Mr. Chairman, I am not a scientist nor an engineer. I can only report the results of some meetings that we have had with people that are studying these matters. And they seem to be of the opinion that within the next 10 to 15 years that the matter of man living under the sea will be far enough advanced so that it might be perfectly possible to—instead of building a platform to drill for oil, that you might build a rig right on the bottom of the ocean with men living in it, and proceeding to and from this rig by some type of a submersible craft, and working down under the ocean rather than above the surface of the ocean.

Mr. LENNON. It is a fact that off the Pacific coast off California and the State of Washington that your Continental Shelves begin to—in a very few cases—begin as little as a mile from the shore, isn't it? I have read that, but I don't know how true it is.

Admiral SMITH. In some places on that coast it drops off quite rapidly.

Mr. LENNON. It is pretty close to shore. I think the average distance on the west coast to where the Continental Shelf begins is about 12 or 16 miles, on an average, less distance than it is on the east coast.

That brings me to your position and the Coast Guard's position on the so-called proposal or resolution—and I know you are familiar with it—that would vest in the United Nations as trustees the ocean bed beyond the Continental Shelf of all of the oceans of the world. They would administer it and make the decisions as to who should exploit it or utilize it, and for what purposes, and where the funds and final resources would go.

I wonder if such a thing becomes a reality and the United Nations, holding the sea beds beyond the Continental Shelves, should see fit to lease to a foreign country a part of the Continental Shelf right off our shores, so to speak, on the west coast or the east coast, either, how would that affect our defense posture? And how would it affect the missions that you have?

There are a lot of real problems, it seems to me, that are posed by this resolution, which will be presented in the presentation of the United Nations General Assembly.

Admiral Smith. Mr. Chairman, I am well aware of this resolution. We have had some of our officers who have been participating in weapon committees and who are looking at this problem—I don't believe I am prepared to speak on it with any authority, but I believe it is a thing that the United States should look at very carefully before making any type of a commitment with respect to this.

Mr. Lennon. We had Admiral Waters here yesterday. And while he didn't say so, there was an implication in his statement of some concern about it. I could understand how he wouldn't want to be categoric on the record, and I am certainly not suggesting that you do so, but Members of the Congress—this committee is concerned with it.

And members of the Foreign Affairs Committee are concerned with this proposal, and hope it can be blunted to a sufficient degree.

Gentlemen, tomorrow we will hear the Department of the Interior representatives and the Smithsonian Institution. Mr. Paul Rogers, one of our most dedicated and loyal members, will chair the committee since I have to chair the Committee on Armed Services tomorrow.

Thank you, gentlemen, very much for your attendance. We appreciate your cooperation, help, and your presence here today.

(The information requested follows:)

SUMMARY OF COAST GUARD COOPERATIVE OCEANOGRAPHIC PROJECTS

Project title	Agency	Commencement date	Termination date	Facilities	Area
Great Lakes waves	(1) Society of Naval Architects and Marine Engineers; (2) U.S. Weather Bureau.	July 1964	Indefinite	CGC "Woodrush"; CG stations.	Great Lakes.
CHURN (hurricane reporting system)	U.S. Weather Bureau	Apr. 18, 1966	do	Coast Guard coastal stations	East coat.
Study of environmental readioactivity and worldwide fallout.	U.S. Navy Radiological Defense Laboratory	September 1965	do	General ship support	Western area.
Collection of specified oceanographic samples and exposure of cesium collection instruments on hydrographic wire.	Scripps Institution of Oceanography	April 1966 (and as requested).	do	OSV to and from Victor, November; WAGB-Operation Deep Freeze.	Do.
Hydrogen and oxygen isotope study	International Atomic Energy Commission	Prior to 1963	do	OSV's at ocean stations B, C, D, and E.	Eastern area.
Radioactive fallout study	U.S. Atomic Energy Commission	Prior to 1963: Ocean Station Echo; July 1965: Bravo, Charlie, Delta.	do	Ocean station vessels at Stations Bravo, Charlie, Delta.	Do.
Surface air sample study	do	October 1965	do	Ocean station vessels at Stations Bravo, Charlie, Delta, Echo.	Do.
Oceanic turbulence	(1) U.S. Naval Underwater Weapons Research and Engineering Station; (2) Massachusetts Institute of Technology.	January 1964	do	Buzzards Bay entrance light station.	New England.
Bathythermograph program	NAVOCEANO		do	Ocean station vessels; WLB's in 14th district, WAGB.	Eastern area. Western area.
Bathymetric sounding	do		do	WHEC, WMEC, WAGO, WLB, WAK.	Eastern area. Western area.
ASWEPS/PAC	do	March 1964	do	Ocean stations vessels	Do.
Surface temperatures	Bureau of Sport Fisheries and Wildlife	August 1964	do	Long-range aircraft	Eastern area. Western area.
Continuous plankton recorder towing program	Scottish Marine Biological Association for Office of Naval Research.	August 1965	do	Ocean station vessels en route to and from stations Bravo and Delta.	Eastern area.
Strontium 90 study	Woods Hole Oceanographic Institution	Prior to 1963	do	Ocean station vessels at stations Bravo, Charlie, Delta, and Echo.	Do.
Great Lakes ice research	Lake Survey project, U.S. Army Corps of Engineers	December 15 (of each year).	April 20 (of each year).	HU-16E from Coast Guard Air Station, Traverse City, Mich.	Great Lakes.
Do	U.S. Weather Bureau	December (each year).	April (each year).	Coast Guard Stations	Do.
Do	Great Lakes Research Division, University of Michigan for Office of Naval Research.	November (each year).	do	CGC "Woodbine" (WLB-289).	Do.
Spring ice breakup reporting	U.S. Weather Bureau	February (each year).	Time of spring thaw.	Coast Guard stations	Do.

SUMMARY OF COAST GUARD COOPERATIVE OCEANOGRAPHIC PROJECTS—Continued

Project title	Agency	Commencement date	Termination date	Facilities	Area
Geophysical research program	Department of Terrestrial Magnetism, Carnegie Institution, Washington, D.C.	October 1965	July 1967	CGC "Woodrush" (WLB–407).	Lake Superior.
Crustal studies (Operation Vela Uniform)	U.S. Geological Survey	1961	Each year: 15 to 30 days duration.	CGC "Woodrush" (WLB–407), CGC "Naugatuck" (WYTM–92), Coast Guard stations.	Do.
Wave recorder-sensor	U.S. Lake Survey, U.S. Army Corps of Engineers			USCGC "Acacia," Coast Guard stations.	Great Lakes.
Water temperature recorders	do			Coast Guard stations	Do.
Aurora observations (borealis)	University of Edinburgh, Scotland	1958	Indefinite	Ocean stations, vessels	Eastern area.
Coastal environmental data	(1) Woods Hole Oceanographic Institution; (2) Scripps Institution of Oceanography.	1955	do	Offshore light stations and lightships.	Eastern area, western area.
Drift bottle observation program	Woods Hole Oceanographic Institution	1955	do	Offshore light stations	Eastern area.
Coast Guard cooperative surf observation program	U.S. Army Corps of Engineers	1954	do	Coast Guard stations	All districts.
Tide observation program	ESSA	1955	do	do	Do.
Wave observation program	U.S. Army Corps of Engineers	1963 (1st district); 1965 (5th district).	do	Buzzards Bay entrance, Chesapeake, and Frying Pan Shoals Light Station.	East coast.
Long period ocean wave oscillation program	Navoceano	1964	August 1967	Buzzards Bay Entrance Light Station, Frying Pan Shoals Light Station.	Do.
Feasibility study of the continuous sampling of plankton procedure as carried out from offshore light stations.	American Museum of Natural History, New York, N.Y.	May 18, 1966	do	Frying Pan Shoals and Chesapeake Light Stations.	Do.
Collection of fouling organisms	Newark Museum, Newark, N.J	October 1965	do	Coast Guard buoys; buoy tender.	Do.

Shallow water environmental program	U.S. Naval Underwater Weapons Research and Engineering Station.	1964	do	Buzzards Bay entrance light station.	New England.
Sea water temperature study	U.S. Navy Fleet Weather Facility, Norfolk, Va	Aug. 26, 1965	do	Coast Guard coastal stations from Ocean City, Md., to Oak Island, N.C.	Mid-Atlantic coast.
Shipworm distribution	Marine Laboratory, Duke University	May 14, 1966	December 1967	Buoys in the Fort Macon area.	Do.
Study of deep ocean buoy moorings	Scripps Institution of Oceanography	December 1963	Indefinite	Ocean station vessels	Western area.
Exposure panel study for fouling and burrowing organisms.	Clapp Laboratories	April 1966	do	Coast Guard stations	East and west coasts.
Collection of amphipods	(1) American Museum of Natural History, New York; (2) Smithsonian Institution.	Sept. 16, 1965	do	Coast Guard buoys; buoy tender.	Mid-Atlantic coast.
Plankton collection program	American Museum of Natural History, New York, N.Y.	July 1966	do	Ocean station vessels en route to and from ocean station Charlie.	Eastern Area.
Oceanographic forecasts on real time basis study	U.S. Navy Fleet Numerical Weather Facility, Monterey, Calif.	March 31 1966	do	Ocean station vessels; CGC "Evergreen" and CGC "Rockaway".	Do.
Eastern tropical Pacific Ocean study (Eastropac)	Bureau of Commercial Fisheries	February 1967	March 1968	CGC "Rockaway."	Do.
Oceanographic/meteorological buoy support	(1) U.S. Navy (buoys), (2) Environmental Science Services Administration (2 buoys).	1964	Continuing	Buoy tenders and bases	Do.
Deep free vehicle observations	Scripps Institution of Oceanography	July 1967	Indefinite	WHEC	Western area.
Albacore collection	Bureau of Commercial Fisheries	April 1967	do	WHEC	Do.
Carbon dioxide equilibration	University of Washington	Spring 1967	Fall 1967	WHEC WAGB	Do.
Sedimentation in coastal canyons	Smithsonian	October 1967	Indefinite	WAGO	Eastern area.
Environmental description of ICNAF fishing area	Bureau of Commercial Fisheries	September 1967	do	WAGO	Do.

(Whereupon, at 12:07 p.m., the committee recessed, to reconvene at 10 a.m., on Thursday, September 21, 1967.)

NATIONAL MARINE SCIENCES PROGRAM

THURSDAY, SEPTEMBER 21, 1967

House of Representatives,
Subcommittee on Oceanography of the
Committee on Merchant Marine and Fisheries,
Washington, D.C.

The subcommittee met, pursuant to recess, at 10:10 a.m., in room 1334, Longworth House Office Building, Hon. Paul G. Rogers presiding.

Mr. Rogers. The committee will come to order, please.

We have two witnesses this morning. We will try to divide the time so each can be heard.

Our first witness is Dr. Stanley A. Cain, Assistant Secretary for Fish and Wildlife, and Parks, of the Department of the Interior.

We shall be pleased to hear you, Dr. Cain. If you would like, you may summarize your testimony, or whatever procedure you prefer will suit the committee.

STATEMENT OF DR. STANLEY A. CAIN, ASSISTANT SECRETARY FOR FISH AND WILDLIFE, AND PARKS, DEPARTMENT OF THE INTERIOR; ACCOMPANIED BY HOWARD ECKLES, PROGRAM MANAGER FOR OCEAN RESOURCES, DEPARTMENT OF THE INTERIOR

Dr. Cain. May I ask Mr. Howard Eckles to come up with me, please?

Mr. Rogers. Yes.

Dr. Cain. If we need them, we have some other staff members whom we will introduce later.

Mr. Rogers. Fine.

Dr. Cain. You gentlemen have before you copies of this testimony. It looks pretty formidable in terms of pages, but the actual text, I think, is not too burdensome, and I will try to shortcut in places and would prefer to read from the text in other places.

Mr. Rogers. Will you so indicate?

Dr. Cain. I will do so.

As a matter of fact, pages 1 and 2 suggest what it is that the testimony is about, and that can simply stand the way it is.

I would call attention on page 3 to a table, the purpose of which is to indicate that the demand for natural resources is growing considerably more rapidly than population, although population growth itself is reasonably rapid. There are estimates here which have been prepared in the Department for 1980 and the year 2000 for the purposes of suggesting that as we go forward we are being confronted with more and more serious demands nationally for certain resources.

Incidentally, we can submit for the record a slight revision of this table which will give somewhat more accurate figures than these, if you would like that. We will do that later. The new table, instead of saying figures are to the 6th or 9th or 15th, will say millions or billions or trillions, or something like that, so they are more legible.

I pick up, then, on page 5 with the last paragraph, where we proceed into some argument for the development of marine resources.

National needs for resources in future years and at present will be met by a variety of sources, all of which will have to be competitive in the marketplace. Where possible, greater quantities of fish will be harvested from the oceans, lower grade ore tailings and metal scrap will be reworked, agricultural productivity will be further increased, and large new water desalination plants will be built, among other things.

In addition to measures to use the untapped resources remaining on land, it is the Department's belief that it will be in the Nation's best interest to discover and develop all aspects of marine resources to provide what is possibly one of the last remaining alternatives for new sources of raw materials available in the territories under U.S. control. As presently visualized, the resources consist of minerals in the sea water solution, those deposited on the ocean floor, and those, including energy resources, in geological formations under the ocean bed. They consist also of living resources for food, water for desalination to supplement supplies of naturally occurring fresh water, and lands and water of the coastal zone which are used for recreational purposes.

We believe, in summary, to stress the point, that it is a most logical step for this country to develop its marine resources for present and future use as a guarantee against growth in future demand and against changes in world situations which could threaten the supply of resources now available to the United States from foreign sources.

We believe further that this is one of the major objectives of the Marine Resources and Engineering Development Act of 1966. It states specifically, among other things, that "there be accelerated development of marine resources of the marine environment."

As the principal conservation agency for the Federal Government, the Department of the Interior is responsible for the development and effective use, in the public interest, of natural resources in both terrestrial and marine environments. The Marine Resources and Engineering Development Act, in addition to the Outer Continental Shelf Lands Act, has broadened the scope of departmental responsibilities for the marine environment by requiring additional attention to resources of the Continental Shelves, an area of at least 1 million square miles of the ocean.

In addition, the Water Quality Act of 1965 and the Clean Waters Restoration Act of 1966 have greatly expanded the Department's authority and responsibility for improving the quality of our water resources in marine environments. Thus, through the combination of water and other resource development and responsibilities for planning, coordination, and support of outdoor recreation, the Department has an extensive involvement in marine scientific and technological affairs.

I might add here, too, that the Department feels a general conservation responsibility which extends to the oceans as well as terrestrially, and I think we mean by this the best and wisest possible management of resources.

In response to the Marine Resources and Engineering Development Act, Secretary Udall assigned new responsibilities to several of his top administrators for the purpose of coordinating the Department's many programs for developing and utilizing marine resources. I was named to lead the team which consists of nine Interior bureaus and offices. This is nine out of, I believe, 23, in the Department. Dr. Walter Hibbard, Director of the Bureau of Mines, is the Deputy Administrator in this program, and an appointment is now pending which would name Mr. Howard Eckles, who sits with me now, from the Office of the Science Adviser in the Department, as Program Manager.

You will find on page 9 a table of this organization. We have a nongovernmental advisory committee shown on the left side of that table, and on page 10 there is a list of the members of this advisory committee. You will see from this that they are distinguished and experienced people in industry and academic circles.

This committee has met twice to advise us, and we have found it to be a very good advisory council.

I say that because they have been penetrating in their analyses of what we do, and they have been very frank in their recommendations. It is an exceptionally strong and good advisory body.

I should like to point out, too, resuming the testimony at the bottom of page 8, that as a further step in strengthening our capabilities in marine science, Dr. Milner B. Schaefer, who was formerly the director of the Institute of Marine Resources of the University of California, and also formerly the Chairman of the National Academy of Sciences Committee on Oceanography, has recently joined the Department as Science Adviser to Secretary Udall. Dr. Fred Singer, a well-known scientist from the University of Miami, has joined the staff of the Assistant Secretary for Water Pollution Control. He is helping to relate estuarine and coastal water pollution control functions to the balance of Interior's marine resources efforts.

It is through this organization and a central focusing of responsibility that we are now administering Interior's program in marine science. The effort is fully coordinated with the planning, programing, and budgeting system now in effect in the Department.

One of the first actions we took was to prepare a report entitled "A Plan for the Accelerated Development of Marine Natural Resources." This appeared toward the close of 1966. This plan was presented to the National Council last February. I believe this is the first department reporting to the National Council in this way, and up to now it is the only one that has done so.

While this was an early effort, it has been helpful as an informational guide to assist our cooperation with the Marine Council. A second plan, which is to be a long-range one in scope, is now in preparation and will be available by the end of this year. A special task force within the Department has been assembled for this purpose.

We have subdivided the Department's marine resource program into four broad categories. These concern food from the sea and the

Great Lakes; marine minerals, which includes marine geology; mining research; and management of the Continental Shelf resources. Our programs concern also research and management to improve quality of water and to combat pollution in the tidal and coastal zones. Lastly, we are considering associated program aspects in marine-based recreation which extends from seashore parks and coastal wildlife refuges and marine game fishing, to the acquisition and development of recreational lands through the land and water conservation fund. This, of course, would be partly Federal acquisition and partly by the States.

Geographic areas of concern extend from the tidal zone of coastal areas to the high seas where U.S. industry is or has a potential for pursuit of distant water fisheries, mineral and energy resources.

We found upon examination of the Department's total involvement with marine resources conservation and development and of activities that were primarily influenced by marine locales, that the programs of the Department were of considerable magnitude both in geographic, manpower, and dollar considerations.

By way of explanation of this point, there is attached a table of budgets by major categories extending from the year 1966 through 1968. That table is presented here on page 13.

I may add, in comparison with other Federal agencies and considering civilian oceanographic activities only, we have a very large budget in comparison with others. I do not mean to imply by that, gentlemen, that it is sufficiently large.

These figures will vary a little bit from those published by the Marine Science Council in its first report because of changes of guidelines as to what would be included. The top level of expenditures expected in marine resource-related activities by the Department of the Interior for the present fiscal year is $128 million.

Through the cooperation of this and other committees of Congress, the Department has been granted over the years a very substantial capability in marine resources, research, and development. We have a staff of over 600 professional personnel in marine resources work. The Department operates 21 high seas ships equipped for biological or geological oceanographic research and for marine mining and fishing engineering development. We have an extensive array of marine resources facilities, including research and technological laboratories, national park and seashore areas, and coastal wildlife refuges.

You will find on pages 15 through 19 a series of charts which show on a classified basis the location and number of these. It will take only a minute for me to give you some figures in this connection.

Looking on page 15, the map shows there are 46 wildlife refuges of significant size that are located on the marine coasts. This does not count any refuges located on the Great Lakes. There are three sport fishery research laboratories in existence, and two under construction.

Turning to map 16 on marine mineral research and exploration, there are three such installations, two on the west coast and one on the east coast.

Turning to the Bureau of Commercial Fisheries, there are 17 biological laboratories, seven technological laboratories, and four exploratory fishing bases, scattered, as you can see, on both coasts and extending up to southern Alaska. Under national parks and seashores there are six national parks, eight national seashores. Five national monuments are coastal. The Federal Water Pollution Control Administration now has in existence four marine or lake laboratories, two dealing with water quality and two having multiple purposes.

I cannot take the time to speak extensively, but the Bureau of Commercial Fisheries has produced in its exploratory work information about new stocks of fish, living resources of the sea, that have been unexploited or underexploited. There are examples given on pages 20 and 21. Food from the sea has been given top priority by the National Marine Council, and the Bureau of Commercial Fisheries of our Department is the major Federal agency which has both the research and technical capacity to expand for our Government a food from the sea program.

If we turn now to page 22: Marine geological research and exploration have turned up interesting and very useful sources of data, such as fresh water aquifers off the coast under salt water overburdens, locations of oil and gas have been discovered, heavy mineral deposits are being discovered and are under exploration at the moment, and so on. There has been considerable activity and this is being accelerated.

At the bottom of page 22 you find, for example, that the Department has administered leases for oil, gas, sulfur, and other material in marine waters which have already since 1954 brought $2.7 billion into the Federal Treasury. The prospect is very great.

On page 23 there are indications about the extent of the activities related to recreation in the coastal zones, both those that relate to the Park Service and those to the Bureau of Sport Fisheries and Wildlife and the overall planning operations in the Bureau of Outdoor Recreation, all of which are detailed.

Interior's goals for the future are by no means spelled out in this document. Three examples of what we feel are some deep needs are given on page 24. The first one relates to our need for a greater marine engineering and technological competence within the Department, not primarily for the purposes of in-house work, but for the purposes of being better able to do our extramural work with industry.

This leads to the second point, that generally speaking the university academic relationships of Interior are much weaker than they should be. This is true for the oceanographic field, but it is generally true of Interior as we compare our situation with other departments of Government.

No. 3 is a very much greater increase in international activities for a whole variety of reasons because it falls in line with national policy with respect to food from the sea and the desperate need of peoples of the world for improved nutrition, particularly protein nutrition. This is in our own national interest also to develop overseas fisheries, both by ourselves and in cooperation with other countries.

I would like to add a fourth point to the three which are mentioned on page 24, and that is the general need of the Department for what one might call a basic inventory of our natural resources. I am new in Government, as you know, and I am constantly surprised at how much we do not know about the environment from which all natural resources are derived. To give you a specific illustration, we certainly need expanded geological studies of the entire Continental Shelf as fast as we can get them. That would be a fourth point.

The testimony has been primarily, as you see, on Interior's internal efforts to coordinate and develop its marine-related programs. The remaining pages, of which there are not very many, relate to a new Committee of the National Marine Council—formed less than a month ago—on the Multiple Uses of the Coastal Zones. Because Interior was so deeply involved in oceanographic matters in many ways, the Council asked Interior to take the lead in this particular Committee. The remaining part of the testimony, a few pages, describes the operation of this Committee.

The Committee is so new that it has met only twice, but it is very broadly representative of Federal Government. The coastal zone and the many possible uses of it have caused practically every agency belonging to the Marine Council to seek membership on this particular Committee. I can assure you it will be a very interesting sort of operation as it goes down the next few months.

Page 26 repeats what you already know, the charge by Vice President Humphrey with respect to the duties and obligations and responsibilities of this Committee.

I believe, gentlemen, that I can close this testimony now. On page 29 you find the Committee composition as it now stands. I am sure it will be expanded, because there is already an expressed interest by the Department of Housing and Urban Development.

The last two or three pages are a sort of gratuity. Because the title of this Committee is the Multiple Uses of the Coastal Zone, I thought there was some usefulness in stating what "multiple use" means. There are some hazards in the term as well as some very important concepts.

Thank you very much, gentlemen. We shall be pleased to do what we can with any questions you may have.

Mr. Rogers. Thank you very much, Dr. Cain, for a very comprehensive survey of Interior's role.

Mr. Pelly.

Mr. Pelly. Thank you, Mr. Chairman.

It is a pleasure, Dr. Cain, to have you appear before our committee today. Several questions have suggested themselves to me.

At a number of places you have referred to resources of the seabed. When you refer to the "coastal zone," as you did at one place in your statement, how far out does this extend and to what depth?

Dr. Cain. When the Committee was appointed and was set up by Vice President Humphrey, it was called Multiple Uses of the Shoreline. So, my first question to Dr. Wenk, of the Council staff, was the same as yours: What does this mean?

We subsequently changed the name to Coastal Zone. It includes the coastline in a strict sense. It includes the estuaries and bays included within, landward to the coastline. It includes the Continental Shelf immediately adjacent. We have not attempted to limit this as yet. We do not know how to limit it. I cannot myself conceive that this Committee's interest in the coastal zone would extend to the seaward margin of the Continental Shelf.

Mr. Pelly. You do not think it would?

Dr. Cain. I doubt that it will. We have not precluded this. It depends upon what problems arise in the Committee function.

Mr. Pelly. Under international law the Continental Shelf is under the sovereignty of the United States is it not?

Dr. Cain. That is correct.

Mr. Pelly. It has a vast amount of minerals.

Dr. Cain. That is correct.

Mr. Pelly. We will have a great shortage of raw materials according to you. Certainly you have indicated by the year 2000 the annual consumption of metals will have more than doubled.

Dr. Cain. Mr. Pelly this question was discussed at the first meeting of the Committee and the State Department raised very serious questions about getting into the problem which is covered by the Committee on International Marine Policy which deals specifically with the outer limits of the Continental Shelf.

We think our interests will be primarily on the inshore territorial waters of the Continental Shelf.

Mr. Pelly. Mr. Reinecke.

Mr. Reinecke. You used the term "committee" several times here. Would you clarify what committee you are talking about? When you said "the committee did not have jurisdiction" did you mean the Merchant Marine Committee or your Committee or the Marine Council or what?

Dr. Cain. This question I gather is related to the very last part of the testimony where I mentioned the National Marine Council Committee on the Multiple Uses of the Coastal Zone. I should have made that clear.

Mr. Reinecke. Thank you.

Mr. Pelly. Is it not a fact that the Department of the Interior has published leasing maps indicating an intent to assume jurisdiction over the ocean bottom as far offshore as 100 miles or to a depth of 6,000 feet?

Dr. Cain. It is true that there have been such maps issued. I think I would like to answer the question this way: The responsibilities of this particular Committee on the Multiple Uses of the Coastal Zone are so ramifying in subject matter that we are trying to restrict ourselves as much as we can geographically. You are quite right that the interest continues certainly as far as any conceivable definition of the Continental Shelf.

Mr. Pelly. Does it not go away beyond that? If we can develop resources under article I of the 1958 Geneva Convention are we not giving the right to develop resources beyond the depth of 600 feet?

Dr. Cain. You are exactly correct.

Mr. Pelly. And will we not need them?

Dr. Cain. I did not intend Mr. Pelly to preclude any outer or seaward limit of the ultimate considerations of this Committee. As we are beginning, our interest is focused more immediately on the actual coastline zone.

Mr. Pelly. You know that right now a number of Members of Congress, including several on this committee are greatly concerned that perhaps these marine resources in which we have such a vital interest may be turned over to the United Nations or some other international body.

The reason I address this question to you is that I am afraid our State Department may be telling you to stay away from this area.

Perhaps the State Department will suggest a United Nations' study of the marine resources with the idea of turning them over to underdeveloped countries. I believe this concept is being considered since many underdeveloped nations do lack such resources.

Dr. CAIN. One further word of clarification. The Ad Hoc Committee on International Marine Policy which was also set up by the National Council has been very active since early May. I am Interior's representative on that Committee. It has dealt with this problem extensively through panels of that Committee just to avoid overlaps between the two Committees and duplication of effort after they have been busy on this problem for about 5 months. The Coastal Zone Committee has so far not undertaken the question which you have raised. This is not a denial of U.S. interest in the problem, not by any means.

Mr. PELLY. The chairman of this committee and a number of the members have introduced similar resolutions indicating that we do not favor the idea of the United States voting to support the Malta proposal made recently in the United Nations. I think our responsibility here is to try to protect the United States. That is this committee's responsibility.

What I am trying to get from you is a statement as to whether on the basis of our projected growth, we actually need the minerals—as you put it, the energy-producing fuels and other resources of the seabed—not only on the Continental Shelf but beyond.

Dr. CAIN. I can answer that question positively, Mr. Pelly. There is a very great national need for resources of the sea. There is no mood in the Department of the Interior in any way to restrict our national ability to exploit these resources. We have the same concern, exactly.

Mr. PELLY. I certainly hope that you will not sit in as the representative of the Department of the Interior on any ad hoc committee or any other group with representatives of other departments of Government and let them talk you out of expressing your Department's interest in mapping out and exploiting in every way possible whatever marine resources we are able to locate.

Dr. CAIN. I cannot prejudge what either the ad hoc committee or the National Marine Council, when the ad hoc committee reports to it on this point, may decide as a committee, but I can say that so far as Interior is concerned, we are satisfied with the status quo. We do not want to rock the boat. We are perfectly willing to let the developments proceed in the next several years for the primary reason that our interest is great and we have the leading technical capacity to do something about it. This is Interior's position, as I understand it. That is all I can comment on.

Mr. PELLY. I certainly want to express, as one Member of Congress, full support for the program you have mapped out to encourage and arrange for leases for all the resources on the Continental Shelf and as far beyond as we are able to exploit and develop them.

Dr. CAIN. Which is allowed under the Geneva Conference?

Mr. PELLY. Which I say is allowed. I am not sure the State Department takes the same position. I think they consider it ambiguous. There is nothing ambiguous to me. I even go a little further, Mr. Chairman. From what legal advice I have been able to obtain from the Library of Congress Law Review Division, I understand that it is not within the province of the executive branch by agreement or treaty, with the approval and consent of the Senate, to give away any material belonging to the United States. I think we have a sovereignty beyond the Continental Shelf and, therefore, it would take the approval of both Houses, the full Congress, to effect its disposal. I am sure they will never get the approval of the House, because we are too close to the people to do any such thing.

Thank you, Mr. Chairman.

Mr. ROGERS. I certainly agree on the point you are making. I oppose any attempt to give away our rights already established under international law.

Mr. PELLY. My point is it is not a case where necessarily we are going to do it at once. Right now, as Dr. Cain has said, we want to stay away from this whole subject. It is a little delicate and touchy. I think we ought to have a firm position right from the start and indicate that we have been given sovereignty if we can develop minerals beyond the Continental Shelf, and that we intend to assert that sovereignty, and in no way should the United Nations call for additional studies and guidelines as to how we can develop those. That is our business, it seems to me.

Thank you.

Mr. ROGERS. I might comment further on that. I think almost all the members of this committee hold this very strong feeling, and to those of you who are in actual contact, helping the Department of State come to some decision, I think this committee would like you to know that we will back up those who take this position strongly with the Department of State. I am sure this committee will make its feeling well known.

Dr. CAIN. Thank you.

Mr. ROGERS. Mr. Reinecke.

Mr. REINECKE. Thank you, Mr. Chairman.

Dr. Cain, you mentioned you would like to preserve the status quo. I think we have to be careful in saying that because the status quo is not a very static thing today, and with what is going on in New York right now I feel, rather than just remain in status quo attitude, we should take a very aggressive attitude toward at least giving ourselves the benefit of every conceivable doubt that we possibly can.

I believe in your position you probably have to wear numerous hats. Particularly I refer to page 7 of your testimony where you mention the Outer Continental Shelf Lands Act which, according to the act, is pretty vague. It apparently gives you jurisdiction over anything that a particular State seems to think was held in sovereignty at the time it became a member of the Union. I do not know what California thought back in 1848, but I am sure if we want to give ourselves the benefit of the doubt and take for the sovereignty and possession of the United States any of those lands, we could make a pretty good case for it, at least to the point of energetically opposing any restrictions at the present time.

Dr. CAIN. Mr. Chairman, if I may further explain my intention when I said to stand on the status quo, and not upset the applecart. What I meant was don't get involved in any new commitments with respect to international aspects of this problem.

Mr. REINECKE. This is true, but let us not turn our backs on any outstanding commitments or concepts that we have.

One or two technical points in your testimony. You referred to the presence of fresh water aquifers off the Florida coast. What is being done to exploit or explore those areas?

Dr. CAIN. To my knowledge, they are not now exploited. They have been discovered. The same thing is true around certain of the Hawaiian Islands where very considerable fresh water resources are available. I do not believe there is any exploitation as of yet.

Mr. REINECKE. Is anything planned?

Dr. CAIN. Dr. James, can you answer that, please?

Dr. HAROLD JAMES (Chief Geologist, U.S. Geological Survey). There are no immediate plans for utilization of the fresh water that has been found offshore off Florida and off Hawaii. It is important, I think, that we know the budget of the fresh water and know what is being lost to the ocean, and whether it could be used if necessary.

Mr. REINECKE. There is reason to think there is fresh water off the coast of southern California, and we would like to find out more about this. I would like to know what else the Department has planned along that line.

You have a very strong program, Dr. Cain. Do you feel Interior is in a position to adopt a lead position with respect to the overall governmental oceanographic program?

Dr. CAIN. In several connections we have made the statement that we in Interior feel that Interior is the Government's principal conservation organization, and what we mean by conservation is the principal resources management organization, for civilian purposes. There are several bases for this.

The first is the responsibilities which, through more than a century, have been assigned to the Department of the Interior by Congress, responsibilities with respect to research and management of natural resources.

The second is that we have in most of these regards the largest staff of scientific and technical people operating in these fields, which is certainly true in geology, and many aspects of geophysics. It is certainly true in the biology of fisheries. It is true in a great many cases. We feel that we are naturally and historically in a lead position with respect to the general matter of marine resources.

Mr. REINECKE. Do you have any liaison between Interior and any other department except through the Council?

Dr. CAIN. Yes, indeed. The most recent one that is pertinent is a memorandum of understanding signed about 2 months ago by Secretary Resor for the Army and Secretary Udall for the Department of the Interior with regard to excavating, dredging, and filling permits which the Corps of Engineers issues on all navigable waters. This is very crucial in the coastal and estuarine waters of the Nation, including the shallow waters of the Great Lakes.

We have working arrangements with the Federal Power Commission. We have working arrangements with other agencies for purposes of coordination of activity. Under the Coordination Act we cooperate with the construction agencies, for example. This means a review of plans for dams, harbor development, channel development, all sorts of things that are related to transportation. We have a series of understandings with other departments of Government. We work very closely with the Navy, also, in many scientific ways.

Mr. Reinecke. The reason I asked the question is because yesterday the Navy put forth the lead agency concept, and they felt they were in a pretty good position, not necessarily to run the show. They did not ask for it, but I think they would like to have it.

Recalling the testimony from the Department of the Interior 2 years ago when we discussed the Marine Resources Act, my recollection is that Interior came right out and made a bid to run the whole Government program. I do not recall who was up here, whether it was you or not, but I know this caused a bit of a stir on the committee, and this is probably one of the reasons we set up the Commission.

That is the reason I am interested to know how ambitious your programs are at the present time. Thank you for your answer.

One more question.

You mentioned the needs on page 24, and one of them was that the work can be expanded and used further in assisting the Department of State, AID, et cetera. Because of your interest in fisheries in the Department, have you made any advances to the Department of State with regard to the seizure of tuna boats off South America?

Dr. Cain. Yes, sir; we have worked and continue to work very closely with the State Department on fisheries problems. The Department of the Interior has representation on nine international fisheries commissions that relate to the oceans, and I think on four or 5 other kinds of international arrangements. So, we are in constant contact with the State Department.

We are particularly concerned about various claims to national territories which in some cases, as you know, extend as much as 200 miles. These problems are continually discussed with the State Department.

Mr. Reinecke. What has your Department done to try to protect the fishermen in these particular cases which may affect other fisheries around the world?

Dr. Cain. For example, the State Department, I think quite properly, does not recognize excessive claims to territorial limits. There is no basis in international law so far for that. When we come to the problem of tuna boats that are arrested or buy licenses, we do not really approve of this. We have no way of stopping a company from buying a license under these conditions. As you probably know, there is legislation before Congress now which would, if passed, cause the Federal Government to give assistance in these difficult problems to the fishing industry so private industries would not bear the whole burden of these difficulties.

Mr. Reinecke. That legislation was proposed on Monday. I was interested to see whether or not your Department was actively pursuing this, because I think it is a national problem.

Dr. Cain. I think I could make the general statement that we do our best to protect American industrial interests in this because they are, in turn, in the national interest.

Mr. Pelly. Would the gentleman yield.

In order that the record may be complete with regard to the legislation for assistance to fishermen who have suffered harassment, I think it only fair to say the House expressed its sense of outrage by defeating that bill. Yet, the Government is not willing to protect our fishermen on the high seas from harassment. Rather it has offered to compensate and, through compensatory type of legislation, it has failed to come to grips with the problem.

I am just as fearful about the handling of our offshore seabeds. We may do the same thing through the United Nations. Certainly, the debate in the House was very clear, as my colleague, Mr. Reinecke, knows full well as one of the authors of that legislation. The indication was we should cut off all aid to countries which illegally seize our fishing boats.

I do not think it can be said that the legislation proposed by the committee met much favor, largely because it was not strong enough.

Dr. Cain. If I may comment, personally speaking, I do not believe the Department of the Interior is in a position or should be in a position, to recommend gunboat protection of our fisheries in these difficult situations or to urge upon the Department of State or AID or any other Federal agency adjustment of other programs for these purposes. I think these policy decisions lie in Congress, lie with the President, lie with the State Department. I think they lie outside of our field. That is my personal feeling.

Mr. Pelly. You have jurisdiction over territories, properties, and other vast holdings all over the world. Certainly, you are not going to take the position that we should not defend our flag or our sovereignty. When a fishing vessel flies the flag of the United States, I think it is entitled to the protection of our Government. It certainly is not getting it now.

Mr. Rogers. Mr. Keith.

Mr. Keith. Is there any conservation legislation that you would suggest to protect the taking of fish that might be trash fish because they were too small for commercial use, but nevertheless, could be sold as trash? For example, fishermen may get flounder in their nets only 2 or 3 inches long and, rather than be forced to throw them back, do they not sell them as trash fish?

Dr. Cain. Are you referring to the use of certain kinds of fish for production of fish meal, for example?

Mr. Keith. Whatever they are used for, fishmeal or fish protein. Conservation is becoming a big problem with our fish resources.

Dr. Cain. Right.

Mr. Keith. I think there is a tendency to go out and catch a lot of fish regardless of size and shape and sell them for 2 or 3 cents a pound or less, and sometimes this fish, if left to swim, would grow up to be a flounder or hake or halibut.

Dr. Cain. There is a Northwest Atlantic Fisheries Treaty Organization, 14 nation.

Mr. Keith. I am aware of that.

Dr. Cain. It deals with questions of mesh size in nets, for the purpose of regulating the catch for conservation purposes, as you have just described.

Mr. Keith. We have domestic regulations with reference to the size of flounder, for example. You have to throw them back if they are too small.

Mr. Pelly. The Halibut Commission certainly limits the size of halibut the American fishermen can take. They have to throw back any small halibut, do they not?

Dr. CAIN. Under this International Treaty Organization, regulations are negotiated and all nations are supposed to employ the same mesh size in their nets.

Mr. KEITH. Is there, to the best of your knowledge, any problem with reference to trash fish catch containing young edible species that would later on be marketable at a higher price and for a better purpose?

Dr. CAIN. For example, the practice is to allow, under the agreement, an incidental taking of perhaps 10 percent of undersized or other kinds of fish, recognizing the inability under certain circumstances to fish in a highly selective manner.

Mr. KEITH. Are you satisfied that our legislation is adequate to protect against the taking of trash fish that would later on serve a more useful purpose?

Dr. CAIN. I think generally our own legislation is pretty good. There is a difficulty in negotiating, internationally, practices that perhaps are as restrictive as our own practices when we are dealing with the high-seas problem.

Mr. KEITH. This morning the Wall Street Journal, I believe it was, had a feature story on what is happening to the lobster, an increase in demand and a lessening in supply. A couple of weeks ago some illegal Canadian lobsters were intercepted, 4,000 of them, more or less. These were egg-bearing lobsters. Do you know what took place in that case?

Dr. CAIN. No, I do not know the case.

Mr. KEITH. It is a landmark case. I believe the fines could have resulted in as much as $400,000 in that particular case.

I think it would be helpful if you could furnish for the record what action the Bureau is taking to make certain we have adequate legislation to protect against such a practice and what action is necessary to assure a more balanced supply of lobster in view of the practices that are depleting that supply at the moment.

(The following material was supplied for inclusion at this point in the record:)

LOBSTER EXPLOITATION

Recent tagging experiments by Bureau of Commercial Fisheries employees at the Boothbay Harbor, Maine, Biological Laboratory indicate that present exploitation rate of lobsters is extremely high. This suggests that increase in supply from nature in any large amounts is unlikely. Investigations are now underway to determine the feasibility of augmenting natural production through husbandry such as construction of artificial reefs and other environmental and culture techniques.

The recent shipment of 4,000 egg-bearing lobsters from Canada to Massachusetts was in violation of Canadian and Massachusetts laws. Such an act is not likely to be repeated very often, especially if a heavy fine is imposed. Our scientists are of the opinion that since these lobsters came from Nova Scotia waters there is little likelihood that they are of the same stock which produces Maine or Massachusetts lobsters. We see no threat to our New England lobster resource; consequently we see no need for legislation.

However, the importation from Canada of egg-bearing lobsters will be unlawful under U.S. Federal law under the terms of an amendment being offered to the Lacey Act by a bill now under consideration in the Congress (H.R. 6138). The prohibition against importation that would be contained in the Lacey Act would apply only where the taking of egg-bearing lobsters was unlawful at the place of taking.

Mr. KEITH. Are you familiar with H.R. 25?

Dr. CAIN. Yes, sir.

Mr. KEITH. You supported this legislation, if I recall correctly.

Dr. Cain. In different forms; yes, sir.

Mr. Keith. On page 21 you talk about a national estuarine study and say:

> This 3-year study and analysis of estuarine uses and problems will have a strong bearing on recreation, commercial fishing, transportation, and other industrial interests.

Is that not parallel to the purpose of H.R. 25?

Dr. Cain. As I read the legislation which authorized the Federal Water Pollution Control Administration study, and the legislation in the present form of H.R. 25, I believe that the intent of H.R. 25 is not in any way to duplicate or overlap the earlier authorization. I so testified at one time, that those sections of H.R. 25 which would establish a national estuary system, and would provide the necesary study for identification of areas that would be an appropriate part of that system, would not be included in the intended survey by the Federal Water Pollution Control Administration.

This is, I believe, the way I testified some months ago on H.R. 25.

Mr. Keith. Since you testified, H.R. 25 has been rewritten?

Dr. Cain. Correct.

Mr. Keith. To provide solely or almost exclusively for a study of the estuary area problem.

How much is the national estuary study costing us currently?

Dr. Cain. I am sorry, I would have to provide that for the record. I do not know what funds are available to FWPCA. I am informed it is about $3 million.

Mr. Keith. I know; the statement says that. I am asking the cost. When was it started?

Dr. Cain. It is due to be finished about the end of next year. It was a 3-year study. I will have to provide the details for the record.

(The material follows:)

ESTUARINE STUDY EXPENDITURES

The National Estuarine Study was authorized in November 1966 to be carried out by the Federal Water Pollution Control Administration.

It is due to be completed in November 1969.

A total of $3 million was authorized by Congress for the study. Estimated actual expenditures are:

Fiscal year 1967	$250,000
Fiscal year 1968	720,000

Mr. Keith. It seems to me those exact details should have been in hand when you spoke with reference to the study that is contemplated under H.R. 25 because, to the extent that there is existing information on the problem, the need for the study would be lessened. I would think it would provide a considerable amount of information in these times of inflation when we have to cut costs where we can.

Further than that, if the problem is worth a study, it is worth getting the input from the studies as we proceed, so we can take action now in some of these areas without waiting for completion of the study.

Are you aware of my marine sanctuaries legislation?

Dr. Cain. Yes, sir.

Mr. Keith. Do you endorse the principle of that legislation?

Dr. Cain. As Secretary Udall's alternate on the Council when the question of open ocean marine sanctuaries came up, I was favorable to that. Subsequently, I have sent the Secretary of Interior two memorandums recommending he consider and have studied the question of the establishment of marine sanctuaries within U.S. territorial waters. So I am personally favorable to this concept; yes, sir.

Mr. KEITH. I think before we permit further exploitation of the inshore resources—and I mean by that those in the territorial waters and perhaps to some extent in Continental Shelf areas where corporations are spending vast sums to discover whether or not there are mineral resources of value, which, once they find them, they will feel by reason of their expenditures they have every right to exploit—that we ought to set aside some areas where they would be restricted.

There are plenty of other areas that could be explored without danger to fishing and marine life. Otherwise, we will run into the same kind of problem you had in the Far West with other mineral resources, both on land and in the sea.

I am glad you personally support this concept.

Dr. CAIN. I would favor extending the concept which is involved in the Wilderness Act from the land to the sea.

Mr. KEITH. Thank you.

Mr. ROGERS. Just a few questions.

What coordination does the Department have with the AEC on waste disposal?

Dr. CAIN. There is a relationship between that and the Federal Water Pollution Control Administration. I believe that is the only connection Interior has with it.

Mr. ROGERS. Do you keep on top of that in the pollution agency or is that pretty much AEC?

Dr. CAIN. As you know, the FWPCA is recently in Interior, and I regret I cannot answer the question specifically.

Mr. ROGERS. If you would let us know for the record.

Dr. CAIN. All right.

Mr. ROGERS. I am very much concerned about this and the waste disposal and its effect on the marine resources.

Dr. CAIN. We will submit for your record information on this.

(The information follows:)

DISPOSING OF RADIOACTIVE WASTES

Disposing of radioactive wastes is controlled by the Atomic Energy Commission through a system of licensing. Regulatory responsibility rests with AEC.

In addition, the Fish and Wildlife Service, through an arrangement between the Secretary of the Interior and AEC, reviews all permit applications for atomic power plant installations and advises AEC on safeguards to protect the natural environment. The Federal Water Pollution Control Administration and FWS also review applications for Department of the Army permits which are required to dispose of wastes in our navigable waters. The Bureau of Commercial Fisheries Radiobiological Laboratory, in cooperation with AEC, conducts research to determine the effects of radiation on marine organisms.

A task group made up of representatives from Interior agencies has studied the problem of waste disposal and recommended that toxic liquid wastes (including radioactive wastes) not be disposed of at sea until a more adequate basis for control has resulted from research.

The practice of disposing of large amounts of low-level radioactive wastes, in containers, in the deep ocean has been discontinued essentially because the capacity of the oceans to receive such wastes is not well known and the danger of uptake of these materials by marine organisms is real.

Mr. ROGERS. Are you doing significant work on actual fish farming?

Dr. CAIN. There is a great deal of fish farming work going on in fresh waters, pond farming. There is research with respect to brackish and salt water with respect to shrimp, for example. It is a field that other nations have developed more rapidly than we have, but we are coming to it, Mr. Rogers.

Mr. Rogers. I would like to know what program you have developed and what you plan to do, particularly with lobster or shellfish, crab, or shrimp.

Dr. Cain. Oysters?

Mr. Rogers. Yes.

Dr. Cain. We will report on that.

(The information follows:)

FISH FARMING PROGRAMS

A number of Bureau of Commercial Fisheries programs are directed toward developing agricultural techniques to raise under controlled conditions, oysters, clams, lobsters, shrimp, pompano, and other marine finfish. We have developed artificial culture methods for oysters and clams, some of which are being tested on a commercial scale. Knowledge about habitat requirement for lobsters is being accumulated and promising beginnings have been achieved by successfully spawning and rearing shrimp. We now can spawn and rear through juvenile stages several species of marine finfish and field tests to raise pompano in ponds are progressing well.

True fish farming of most marine species, however, still is in its infancy in this country. Much more basic knowledge is needed of the biological and nutritional requirement of most species as well as economic studies to learn how to raise them at a profit under various types and levels of farming and management. Our long-range studies are intended to provide this type of information so true "fish farming" of marine species can become a reality.

Mr. Rogers. I do not think people realize this potential. I am glad to see that you are making people aware of the revenues brought into the Federal Government. I believe you said $2.7 billion, from natural resources.

Dr. Cain. Royalties from oil and gas, and sulfur, and this sort of thing; yes, sir.

Mr. Rogers. Could you give us a projection as to what we may expect for the next 10 years and let us have that for the record?

Dr. Cain. We will provide it for the record.

Mr. Rogers. I think it would be helpful to give us some idea of what we may expect so we can relate it to your testimony.

(The information follows:)

REVENUES DERIVED FROM THE OUTER CONTINENTAL SHELF

Natural resources (bonuses royalties, and rentals on oil, gas and sulfur) have brought a total of about $2.7 billion into the Federal treasury. Following is a breakdown of revenues from the Outer Continental Shelf for the past 2 years:

	Calendar years	
	1965	1966
Royalties:		
Oil and condensate	$80,408,174	$103,707,597
Gas	19,248,110	29,142,325
Sulfur	3,197,532	4,128,691
Salt	8,724	8,924
Total royalties	102,862,540	136,987,537
Rentals	8,515,378	7,085,277
Bonuses	33,740,309	209,199,893
Total royalties, rentals, and bonuses	145,118,227	353,272,707

We can reasonably expect to collect an additional $3.5 billion over the next 10-year period.

Mr. ROGERS. What has happened on the $700 million supposed to be in escrow in Louisiana?

Dr. CAIN. It is still in escrow as far as we know.

Mr. ROGERS. What is the difficulty there; determining whether it should go to the State or the Federal Government?

Are efforts being made to do anything about the $700 million?

Dr. CAIN. We think it is a problem in the Attorney General's Office, but we do not know.

Mr. ROGERS. We will make an inquiry.

(The following was received in response to the above:)

LOUISIANA-U.S. BOUNDARY DISPUTE

The escrow fund has grown to about $900 million. This amount is still in escrow and growing steadily.

The difficulty here is settling the dispute as to the historical boundary of the State of Louisiana. Once that is settled, the part of the disputed area of the Continental Shelf belonging to Louisiana may be precisely defined and the escrow fund divided proportionately.

It is our understanding that a continuous effort is being made to settle the dispute between Louisiana and the United States. A settlement, of course, will directly affect the escrow fund.

Mr. ROGERS. You have maps for leasing on the Continental Shelf?

Dr. CAIN. There have been maps issued, yes. Some go to considerable depth and considerable distance from the shore.

Mr. ROGERS. What is the greatest depth you estimate and the greatest distance?

Dr. CAIN. I think the depths that have been involved are a few thousand feet, but this needs explanation.

Mr. ROGERS. All right.

Dr. CAIN. These are really relatively small on Continental Shelf waters which happen to have deep trenches within them. It is not an average great depth which is involved.

Mr. ROGERS. How far out do they go?

Dr. CAIN. About a hundred miles.

Would you like a definitive statement on the leasing situation?

Mr. ROGERS. Yes, I think this would be helpful.

(The following was received in response to the above:)

CHARTING PROCEDURES FOR THE CONTINENTAL SHELF

Generally speaking, maps for leasing on the Continental Shelf are prepared out to a water depth of approximately 600 feet. In the Gulf Coast areas, where the water is relatively shallow, the maps may extend out as much as 130 miles from the coast line.

On the west coast, where the water depth increases rapidly, the 600 foot depth may be reached in just a few miles. In this area most maps extend beyond the 600 foot depth. The greatest depth encountered on present leasing maps is approximately 2,000 feet in the Channel Island area off the coast of California.

Mr. ROGERS. I would also appreciate knowing the number of leases, whether they are increasing in number or decreasing. And whether they are mainly oil companies.

It would be appreciated if you could give us a picture of who is doing the operations in this area.

Dr. CAIN. Yes, sir.

(The information follows:)

LEASING OF THE CONTINENTAL SHELF

The number of leases on the Outer Continental Shelf has been increasing at an average rate of about 15 percent per year. On June 30, 1967, there were 954 leases, covering 4.15 million acres, in effect on the Outer Continental Shelf. This number is expected to increase rapidly in the next few years since several large offshore lease sales are being planned. Oil companies hold, by far, the greatest proportion of the leases on the OCS. A few large sulphur companies are conducting operations and several combines formed from independent and/or the smaller integrated oil companies are represented in the offshore area. The OCS produces approximately one-half of the oil and gas produced from *all* Federal lands.

Mr. ROGERS. What is the formula for setting of royalties, or is there one?

Mr. ECKLES. Mr. Chairman, may I explain neither Dr. Cain nor I are actually experts in this particular area, but we have some general information.

The formula for setting the royalties, as I understand it, is specified in the legislation for the Outer Continental Shelf Act which the Interior Department administers.

Mr. ROGERS. Would you give us an explanation of how this is done for the record?

Mr. ECKLES. Yes, sir.

(The information follows:)

ROYALTY FORMULA FOR OUTER CONTINENTAL SHELF

The royalty rate for oil and gas production from Federal leases on the OCS is set by the Secretary of the Interior, but can be not less than 12½ percent. The minimum royalty rate is specified by the OCS Lands Act.

The Secretary of the Interior, with technical and petroleum engineering assistance from the U.S. Geological Survey, determines the reasonable royalty rate to set for production from Federal leases on the OCS. So far, all leases issued by the Federal Government have provided for a 16⅔ percent royalty rate.

Dr. CAIN. I can add, now, it is usually a royalty with competitive bidding on the basis of cash bonus.

Mr. ECKLES. This is the normal operation in oil and gas.

Mr. ROGERS. It is my understanding from counsel that you have just issued some leases off the west coast at a depth of some 1,500 feet. Is this correct, three of them?

Mr. ECKLES. Yes.

Mr ROGERS. Can you give us some explanation on that and how deep you have gone on both coasts and the gulf and the distances?

(The information follows:)

WATER DEPTHS OF LEASES ISSUED

Three leases have been issued off the coast of Oregon in water depths of approximately 1,500 feet. However, these leases are located only about 31 miles from the coast line in an area of rapidly increasing water depth. These three are, of course, the deepest water locations of any leases on the west coast and are about the farthest from shore for that area. In the Gulf of Mexico, the maximum depth of water in which leases have been issued is about 500 feet. Also, on the Gulf coast, leases have been issued at a distance of slightly over 100 miles from shore.

Mr. ROGERS. Is that beyond the Continental Shelf off the west coast?

Dr. CAIN. I believe not.

Mr. ROGERS. In shelf water?

Dr. Cain. You get a little problem sometimes in terms of geomorphology as to how you define the shelf. I refer to deep trenches that interrupt more shallow bottoms.

Mr. Rogers. You might tell us whether this is specifically within the Continental Shelf. I would hope they are not. I would hope they are beyond it so we can start using the Geneva Conference.

(The information follows:)

Boundaries of the Outer Continental Shelf

The Department of the Interior regards areas which it has leased under the Outer Continental Shelf Lands Act as being on the Continental Shelf of the United States.

Mr. Rogers. You mention new stocks of fish. Could you give us a rundown a little bit on the work in this area?

Dr. Cain. You mean from our exploration activities, the new stocks that have been unexploited or underexploited?

Mr. Rogers. Yes, and maybe any other facts as to where you have discovered or where they have not fished before and discovered resources.

For instance, I understand off Florida they are finding shrimp at a depth where they have never been fished. I think this helps us to know what these resources are.

(The following material was received in response to the above:)

New Stocks of Fish and Shellfish Discovered in Recent Years

Fishery surveys in recent years by the Bureau of Commercial Fisheries have defined a number of undeveloped or underdeveloped stocks of fish and shellfish, including shrimp off Alaska, hake and groundfish in the Pacific Northwest, anchovy off the west coast, thread herring in the Gulf of Mexico, calico scallops off Florida, and surf clams and ocean quahogs along the Atlantic coast. Viable commercial fisheries have developed in many instances from these surveys. The commercial fishery for Alaskan shrimp produced 28.0 million pounds valued at $1.3 milion in 1966. In the summer of 1967, during 2½ months of fishing by 10 vessels, the commercial yield from the Pacific hake fishery was 20.0 milion pounds. The anchovy catch off the west coast in 1966 was 60.5 million pounds valued at $650,000. Potential annual yields of Pacific groundfish off the Pacific Northwest and Alaska coasts, such as Pacific ocean perch and pollock are estimated to exceed 150 milion and 500 million pounds respectively. The potential yield of thread herring in the Gulf of Mexico is estimated at 2.5 billion pounds annually. During late summer 1967, commercially significant concentrations of calico scallops were delineated off the Florida coast, and arrangements are currently being made by industry representatives in North Carolina and Florida to harvest these resources. New beds of surf clams and ocean quahogs were also discovered along the Atlantic coast during 1967, some of which were utilized by the fishing industry.

Mr. Rogers. What work is being done on obtaining an inventory of the natural resources, particularly on the Continental Shelf? Are you doing any work here?

Dr. Cain. One of the express needs which is in the testimony I can explain as follows:

I think I did mention that the Geological Survey feels, and we feel, a very great need for a study of the entire Continental Shelf from the point of view of geology. We have a very real need in food from the sea to extend our exploration activities.

On the discussion that came up with Mr. Keith, we do not know enough about the resource complexes of the coastline now to judicially try to establish a sanctuary system or national estuary system, so we have this fundamental need for more knowledge about the resource base we operate from.

Mr. ROGERS. What proposals have the Department made to accomplish this?

You can supply this for the record. Let us know what you propose, what the funding would be, and what personnel would be needed to carry it out. It is essential to get some specific facts to help us move on this. I would think this is very vital.

(The following was supplied in response to the above:)

INVENTORY OF NATURAL RESOURCES OF CONTINENTAL SHELF AND OPEN OCEAN

The Bureau of Commercial Fisheries conducts exploratory fishing surveys on and beyond the continental shelf from five Exploratory Fishing and Gear Research Bases located at strategic points along the U.S. coast. A total of six Bureau-owned exploratory fishing and gear research vessels, ranging in length from 65 to 170 feet, are operated from these bases and are used for both exploratory and gear research. There is also one base in the Great Lakes.

The work of this fishery survey program has resulted in the definition, location, and extent of a number of resources and the start of several new fisheries; for example, swordfish longlining in New England waters, calico scallops and royal red shrimp off the South Atlantic States, shrimp off the northeast coast of South America, tuna in the Gulf and Caribbean, hake and groundfish in the Pacific Northwest, and king crab and shrimp in Alaska.

Several years ago, the Bureau started to compile the extensive information obtained over this exploratory period of some 20 years into a series of "faunal atlases" that will show the present state of our knowledge about these resources and indicate the major gaps. At the present level of funding, however, this series will take many years to complete. From a preliminary analysis of all available data, it was estimated that the potential annual production from the U.S. continental shelf and adjoining offshore areas could equal approximately 28 billion pounds valued at $1.5 billion to the fisherman.

Our knowledge is poor or lacking, however, on the distribution and abundance of many of the species on which this estimate is based, particularly on the herring-like fishes, sharks, flounders, pollock, shrimp and squid. In order to harvest and manage these resources effectively, information would be needed on the size and distribution of the fish stocks, their growth and natural mortality, reproductive rate, and nature of subpopulation structure. Entirely new harvesting methods might be required before the industry could operate effectively on some of these species. New products and new methods of processing would be needed to interest the U.S. public in adding some of these forms to their diet; the squid, for example. Many of the species cited would be suitable raw material for the production of Fish Protein Concentrate (FPC) or for fish meal and oil.

The Bureau plans to continue its fishery surveys and gear development work as extensively as available funds and staffing will permit. A new exploratory vessel, the *Oregon II*, was delivered in August 1967 and will be based as Pascagoula, Mississippi, for work in the Gulf and Caribbean. A second new vessel, the *Delaware II*, is now under construction. The Bureau was granted design money in FY 1964 for the construction of two additional exploratory vessels. Plans have been completed for these vessels but no construction funds have been received as yet.

In September 1966, in connection with hearings on S.J. Res. 29, the Bureau was asked to submit a proposal for a continental shelf and fresh water fishery survey program. The proposal prepared at that time called for a 4½-year program, costing a total of about $28 million and requiring the services of 254 people and 30 vessels to complete.

PROPOSED MARINE GEOLOGY AND HYDROLOGY PROGRAM, FOR STUDY OF CONTINENTAL SHELVES

The geological survey conducts a program which began in 1962 with the broad investigation of the Atlantic Continental margin from Nova Scotia to Florida. This was our major Federal Government attempt to analyze the geologic framework and history of a large segment of a continental borderland for potential resources. Already the results are being used by oil and mining companies in their exploration programs. The Atlantic Continental Shelf represents about one-sixth of the Nation's total shelf area, and we now urge similar efforts off our other coasts to provide the framework of reference for the more detailed studies that relate to specific objectives such as the search for heavy metals, the evaluation of geologic hazards, and hidden resources.

The program that we propose is a balanced National program with the following four goals:

(1) Completion in 5 years of 80 percent of the shelf area at a reconnaissance scale (1:1,000,000);

(2) Completion in 5 years of 10 percent of the shelf area at an intermediate scale (1:250,000);

(3) Concurrent detailed mapping (1:62,500) and analysis in areas of high economic potential or where National needs dictate;

(4) Expand our capacity to work in deep sea areas especially off Hawaii and island territories.

If this Nation in years ahead is to make effective use of the resources beneath the sea, this geologic information must be acquired prior to the major thrust of exploration and development of the shelves. The reconnaissance scale geologic investigation of the continental shelves is the first step toward meeting this need.

Geologic investigation at an intermediate scale of 1:250,000 will provide a more detailed analysis of promising areas that have been brought into focus by the reconnaissance work, or of areas where our onland geologic knowledge indicates a high resource potential offshore.

Detailed geologic studies and mapping at scale of 1:62,500 and larger will be conducted concurrently with the reconnaissance and intermediate scale mapping, specifically in selected areas of high economic potential, or where the need exists for investigations of geologic hazards or use of submerged lands, or for the study of critical geologic processes.

Geologic exploration of the deep ocean floor and the areas off island territories will provide fundamental information to assess the resource potential and to provide guidelines for development of National policy in problems of ownership and use.

We will carry out our marine program in four ways: (1) by our own in-house research capabilities utilizing data from our investigations and those provided by institutions and by industry; (2) through research contracts with universities and institutes; (3) service contracts with industry; and (4) cooperative programs with other federal agencies such as those started this year with the Bureau of Mines, Bureau of Commercial Fisheries, Naval Oceanographic Office, Naval Electronics Laboratory, and ESSA.

The funding and staffing required for such a program has been estimated by the Geological Survey as progressively increasing from the present funding of $1.2 million and professional staff representing 21 man years to a funding base of $14.5 million and a staff of 120 professionals in 1973.

PROPOSED MARINE RESOURCES EVALUATION PROGRAM FOR CONSERVATION AND SUPERVISION OF DEVELOPMENT

The Geological Survey also proposes to implement a strong, continuing geologic and engineering evaluation program in support of oil and gas leasing and supervision on the Outer Continental Shelf.

Data in the form of well logs and cores, which Federal lessees are required to furnish, have accumulated since the beginning of OCS operations in 1953. These data have been used to aid supervision but manpower limitations have prevented their full evaluation and utilization. Systematic analysis of these data will (1) provide a basis for identifying realistic minimum values to be used as the lowest acceptable bid for leases offered for sale, (2) identify areas subject to drainage of oil or gas and thus subject to lease for that reason, and (3) provide information for evaluation of secondary recovery and unitization proposals. Information obtained from this program will add significantly to basic knowledge of the geology and mineral resources of the continental shelves.

The OCS includes the largest unexplored domestic areas where significant new discoveries of minerals and fuels are likely to occur. Adequate funding for the OCS leasing and supervision program is vital to meet the responsibilities of the Department in connection with increasing exploratory activities necessary to meet increased demands for fuels and minerals.

The funding required for this program and the professional staff to implement it have been estimated by the Geological Survey to be $600,000 and 12 professional employees by 1973.

Mr. Drewry. Dr. Cain, one of the purposes of this series of hearings is to try to get a picture of the total marine sciences effort in the government. For purposes of comparison and understanding, we hoped that the same language would be used throughout.

In your table on page 13 you list under the heading "Marine Resources and Engineering Developments" a number of major purposes and the actual amounts for fiscal 1966, the estimated for 1967, and the budget for 1968.

I was taking a look at those figures and the categories to which they are assigned in comparison with similar categories, identical categories in the Marine Council's first report, and I do not find that any of the figures compare with each other, as far as I can tell. You have $128 million for fiscal 1968 and I believe $72.3 million is what the Marine Council report shows.

You do, on page 14, make the statement that these figures will vary from those published by the Marine Council in its first report because of the inclusion of additional amounts for acquisition of marine-based recreational areas. While that may explain a little bit, it does not explain a lot of others such as fisheries resource assessment, geological investigations, and so on.

Can you either briefly explain that now or submit a statement for the record?

Dr. Cain. I think Mr. Eckles can explain that now.

Mr. Eckles. I can comment for the moment.

Mr. Rogers. Our time is almost up.

Mr. Eckles. The principal major difference in these figures is that we have included here the cost of acquisition of marine-based recreational areas, and this is a substantial difference. This is a question of definition. The other ones are question of balance between what the actual expenditures were as the programs were finished versus what were estimates at the time the Marine Council's report was published.

In essence, programwise, there is no real major difference or change between those figures and what we have reported here.

Mr. Drewry. I think it would be helpful if you could at least supply for the record a detailed explanation of these variations, because, for example, under the heading of "actual" for 1966, the "actual" in the eyes of the Marine Science Council comes out different from the "actual" for you. My understanding was that you were working with the Council.

Mr. Eckles. That is right.

Mr. Drewry. In fact, I assumed you would supply the basic figures to them. This is a problem we have had ever since 1959 in trying to determine whether we are using the same language when we talk to one agency as we are when talking to another as to what the magnitude of the program is. So I think it is important that the record show something to clear up this point.

That is all I have, Mr. Chairman.

(The information follows:)

BUDGETARY DIFFERENCES BETWEEN MARINE COUNCIL REPORT AND INTERIOR DEPARTMENT STATEMENT

One reason for the difference between the budget figures published in the Marine Council Report and those furnished in this statement is a change in definition. The published report used the concept of obligations incurred while the recent statement was developed on the basis of costs incurred. Costs incurred can be defined generally as actual disbursements plus accounts payable, whereas obligations incurred are firm commitments by contracts, purchase orders, etc. and precede actual payment. Part of the difference which occurred in FY 1967 can be attributed to the subsidy for the construction of fishing vessels and to a program of Federal Aid for Commercial Fisheries Research and Development. The difference applicable to the subsidy operation is $4.7 million. The difference applicable to Aid to States is $2.6 million.

Other differences resulted in a restudy of projects being included as an appropriate part of marine science research such as in the saline water conversion program. Definitions of program content once adjusted for FY 1968 were adjusted accordingly in the year 1966 and 1967 in an effort to make the levels of effort comparable.

Mr. ROGERS. We appreciate your testimony, Dr. Cain, and your associate's. You have been most helpful. We appreciate the work that the Interior Department is doing in this field.

Dr. CAIN. Thank you.

(The prepared text of Dr. Cain's statement follows:)

STATEMENT OF STANLEY A. CAIN, ASSISTANT SECRETARY FOR FISH AND WILDLIFE, AND PARKS, DEPARTMENT OF THE INTERIOR

Mr. Chairman and members of the committee, it is my pleasure to appear before you today to speak in accordance with your request, in a dual capacity. First, I will present an overview of the Department of the Interior programs in marine resources development, in my capacity as Administrator of department-wide programs in marine resources. Second, I will discuss activities and plans of a committee of the National Council on Marine Resources and Engineering Development which concerns the multiple use of the coastal zones of the United States. I will speak first on the need for marine resources development and the role which the Department of the Interior is playing meeting national needs in this field. Following my remarks on this subject, I will then give a brief review of the newly formed Committee on Multiple Use of Coastal Zones.

As an introduction to the question on why this nation should be concerned about development of latent marine resources, I would like to introduce data that indicate requirements for natural resources extending to the year 2000. These show expected population growths as determined by the Bureau of Census coupled with information on expected requirements for natural resources. The intent is to obtain a reasonable comparative measure of resource demands. The indicators are population growth and requirements linked to standards of living.

INDEXES OF NATIONAL ANNUAL REQUIREMENTS OF NATURAL RESOURCES, 1950 TO 2000

	1950	1965	1980		2000	
			Amount	Percent increase [1]	Amount	Percent increase [1]
Population times millions	152	194	[2] 238	23	[2] 315	62
Gross national product times billions [3]	$458	$666	$1,254	88	$2,900	335
Disposable personal income times billions [3]	$267	$457	$756	65	$1,473	222
Energy demand times quadrillion British thermal units [4]	34.5	50.6	82.4	63	136	169
Metals consumption times millions [3]	$8,100	$8,805	$13,058	48	$22,085	151
Water times billions of gallons per day	203	372	509	38	770	107
Fishery products times millions [3]	$669	$996	$1,345	39	$2,092	116

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[1] Percent increase over 1965.

[2] Average of moderate and substantial declines in fertility rates, Bureau of the Census, series P–25. The year 2000 estimate is an extrapolation of the 1965–80 data.

[3] Relative to constant 1964 dollars.

[4] Fossil fuels, nuclear and hydro; nuclear is nonrenewable until about 2000 when breeders will have been developed.

It is apparent that the population in 1980 will have increased, in comparison with that existing in 1965, by only about 25% while such indices of economic activity as the Gross National Product and Disposable Personal Income will have increased from 3 to 4 times this percentage. Similarly, the consumption of the natural resources specified in the table increases significantly faster than the population but less than the indices of economic activity.

By the year 2000, the population will have increased only by about 60% but the Gross National Product and Disposable Personal Income are expected to increase by factors of 5.5 and 3.5 times this amount respectively. Thus the production of goods and the demand for services is expected to far outstrip the population increase. This disparity is linked to a rising standard of living derived from higher disposable personal incomes, more sophisticated technological developments, and changes in social and cultural values. All will combine to create highly intensified competition for the natural resources available to the nation. To give some measure of the demand that will be made on the resources of this country—a measure that may be difficult to comprehend : if one assumes that the Gross National Product will continue to increase at about 4.2% per year, as it has in the past five years, then the total Gross National Product produced between the present and the end of the century will exceed by a factor of about two the total Gross National Product of this country since its founding.

The Gross National Product is a composite of goods and services at market prices. Present data indicate that the demand for services is increasing faster than the requirements for products. Hence, the consumption of energy producing fuels, metals, water, and fish rather than Gross National Product are probably more accurate indicators of the future requirements for natural resources. The natural resources listed consist of nonrenewable ones; that is, fossil fuels and metals, and renewable ones, fresh water and fish. The *annual* consumption of metals in 2000 will have increased to more than double that in 1965. Thus the total demand for metals between 1965 and 2000 will amount to $505,000 millions (1964 dollars) while only about $420,000 millions worth of metals have been consumed since 1775.

National needs for resources in future years and at present will be met by a variety of sources, all of which will have to be competitive in the market place. Where possible, greater quantities of fish will be harvested from the oceans, lower grade ore tailings and metal scrap will be reworked, agricultural productivity will be further increased and large new water desalination plants will be built.

In addition to measures to use the untapped resources remaining on land, it is the Department's belief that it will be in the nation's best interest to discover and develop all aspects of marine resources to provide what is possibly one of the last remaining alternatives for new sources of raw materials available in territories under United States control. As presently visualized, the resources consist of minerals in sea water solution, those deposited on the ocean floor and those, including energy sources, in geological formations under the ocean bed. They consist also of living resources for food, water for desalination to supplement supplies of naturally occurring fresh water, and lands and water of the coastal zone which are used for recreational purposes.

We believe, in summary, to stress the point, that it is a most logical step for this country to develop its marine resources for present and future use as a guarantee against growth in future demand and against changes in world situations which could threaten the supply of resouces now available to the U.S. from foreign sources. We believe further that this is the intent behind one of the major objectives of the Marine Resources and Engineering Development Act of 1966. It states specifically, among other things, that "there be accelerated development of marine resources of the marine environment."

As the principal conservation agency for the Federal Government, the Department of the Interior is responsible for the development and effective use, in the public interest, of natural resources in both terrestrial and marine environments. The Marine Resources and Engineering Development Act, in addition to the Outer Continental Shelf Lands Act, has broadened the scope of Departmental responsibilities for the marine environment by requiring additional attention to resources of the continental shelves, an area of at least one million square miles of the ocean.

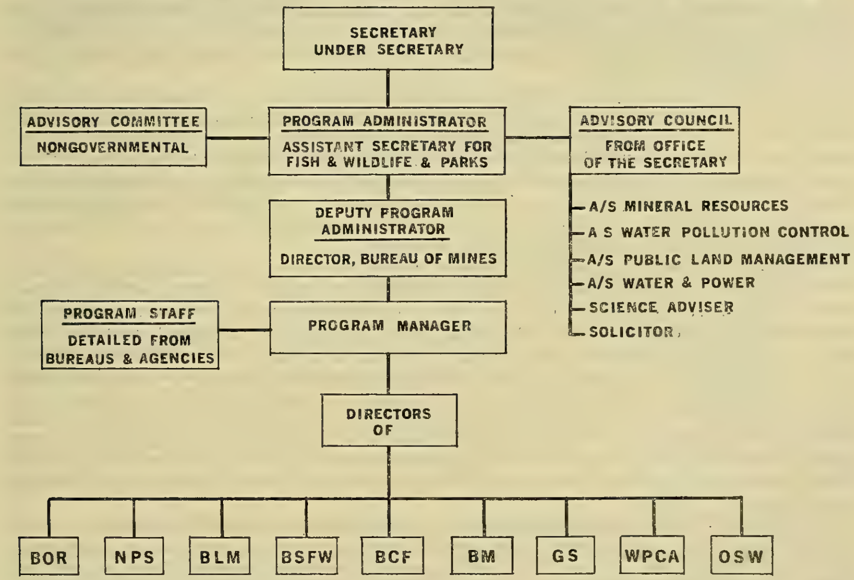
In addition, the Water Quality Act of 1965 and the Clean Waters Restoration Act of 1966 have greatly expanded the Department's authority and responsibility for improving the quality of our water resources in marine environments. Thus, through the combination of water and other resource development and responsibilities for planning, coordination and support of outdoor recreation, the Department has an extensive involvement in marine scientific and technological affairs.

In response to the Marine Resources and Engineering Development Act, Secretary Udall assigned new responsibilities to several of his top administrators for the purpose of coordinating the Department's many programs for developing and utilizing marine resources. I was named to lead the team which consists of nine Interior Bureaus and Offices. Dr. Walter Hibbard, Director of the Bureau of Mines, is my Deputy Administrator in this program and an appointment is now pending which would name Mr. Howard Eckles, from the Office of the Science Adviser in the Department, as Program Manager.

As shown on the accompanying organizational chart, we have also appointed a non-governmental Advisory Committee. The members are outstanding men from universities and industry who can represent broad fields of marine research and resource development. Assistant Secretaries of Interior who have responsibilities for marine resources also act as an Advisory Council to me and to Secretary Udall in the discharge of our duties in the coordination and administration of marine resource programs which are of concern to more than one Bureau or Assistant Secretarial offices.

I should point out, too, as a further step in strengthening our capabilities in marine science that Dr. Milner B. Schaefer, who was formerly the Director of the Institute of Marine Resources of the University of California and also for-

INTERIOR'S ORGANIZATION FOR ITS MARINE RESOURCES DEVELOPMENT PROGRAM


SECRETARY
UNDER SECRETARY
ADVISORY COMMITTEE
NONGOVERNMENTAL
PROGRAM ADMINISTRATOR
ASSISTANT SECRETARY FOR FISH & WILDLIFE & PARKS
ADVISORY COUNCIL
FROM OFFICE OF THE SECRETARY
DEPUTY PROGRAM ADMINISTRATOR
DIRECTOR, BUREAU OF MINES
A/S MINERAL RESOURCES
A S WATER POLLUTION CONTROL
A/S PUBLIC LAND MANAGEMENT
A/S WATER & POWER
SCIENCE ADVISER
SOLICITOR
PROGRAM STAFF
DETAILED FROM BUREAUS & AGENCIES
PROGRAM MANAGER
DIRECTORS OF
BOR
NPS
BLM
BSFW
BCF
BM
GS
WPCA
OSW

merly the Chairman of the National Academy of Sciences Committee on Oceanography, has recently joined the Department as Science Adviser to Secretary Udall. Dr. Fred Singer, a well known scientist from the University of Miami, has joined the staff of the Assistant Secretary for Water Pollution Control. He is helping to relate estuarine and coastal water pollution control functions to the balance of Interior's marine resources efforts.

MEMBERSHIP, DEPARTMENT OF THE INTERIOR, MARINE RESOURCES DEVELOPMENT PROGRAM ADVISORY COMMITTEE

Mr. D. Otis Beasley, Standard Oil of Indiana.
Mr. F. Gilman Blake, Chevron Research Corporation, La Habra, California.
Mr. Vernon E. Brock, Department of Oceanography, The University of Hawaii.
Dr. William T. Burke, College of Law, The Ohio State University, Columbus, Ohio.
Dr. Preston E. Cloud, Jr., Department of Geology, University of California, Los Angeles, California.
Mr. John R. Gilbert, Vice President, Bumble Bee Seafoods, Seattle, Washington.
Dr. Frederick C. Kruger, Stanford University, Palo Alto, California.
Mr. Francis L. LaQue, Vice President, The International Nickel Co., Inc., New York, N.Y.
Mr. Henry Lyman, Publisher, The Salt Water Sportsman, Boston, Massachusetts.
Dr. Grover C. Murray, President, Texas Tech University, Lubbock, Texas.
Dr. Donald Pritchard, Director, Chesapeake Bay Institute, The Johns Hopkins University, Baltimore, Maryland.
Dr. John H. Ryther, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts.
Dr. James A. Storer, Dean of the Faculty, Bowdoin College, Grunswick, Maine.
Mr. Allyn Vine, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts.
Dr. Warren S. Wooster, Scripps Institution of Oceanography, University of California, La Jolla, California.

It is through this organization and a central focusing of responsibility that we are now administering Interior's program in marine science. The effort is fully coordinated with the Planning, Programming and Budgeting system now in effect in the Department.

One of the first actions we took was to prepare the report entitled "A Plan For The Accelerated Development of Marine Natural Resources." This plan was presented to the National Council last February. I believe that members of this committee have also received copies of it. While this was an early effort, it has been helpful as an informational guide to assist our cooperation with the Marine Council. A second plan which is to be long-range in scope is now in preparation and will be available by the end of the year. A special Task Force within the Department has been assembled for this purpose.

We have subdivided the Department's Marine Resource Program into four broad categories. These concern *food* from the sea and the Great Lakes, *marine minerals* which includes marine geology, mining research and management of Continental Shelf Resources. Our programs concern also research and management to improve quality of *water* and to combat pollution in the tide and coastal zones. Lastly, we are considering associated program aspects in *marine-based recreation* which extends from seashore parks, coastal wildlife refuges and marine game fishing to the acquisition and development of recreational lands through the Land and Water Conservation Fund. Geographic areas of concern extend from the Tidal Zone of Coastal Areas to the high seas where U.S. industry is or has a potential for pursuit of distant water fisheries, minerals and energy resources.

We found, upon examination of the Department's total involvement with marine resources conservation and development and of activities that were primarily influenced by marine locales, that the programs of the Department were of considerable magnitude both in geographic, manpower and dollar considerations. By way of explanation of this point, there is attached a table of budgets by major categories extending from the years 1966 through 1968.

MARINE RESOURCES AND ENGINEERING DEVELOPMENT

[In millions of dollars]

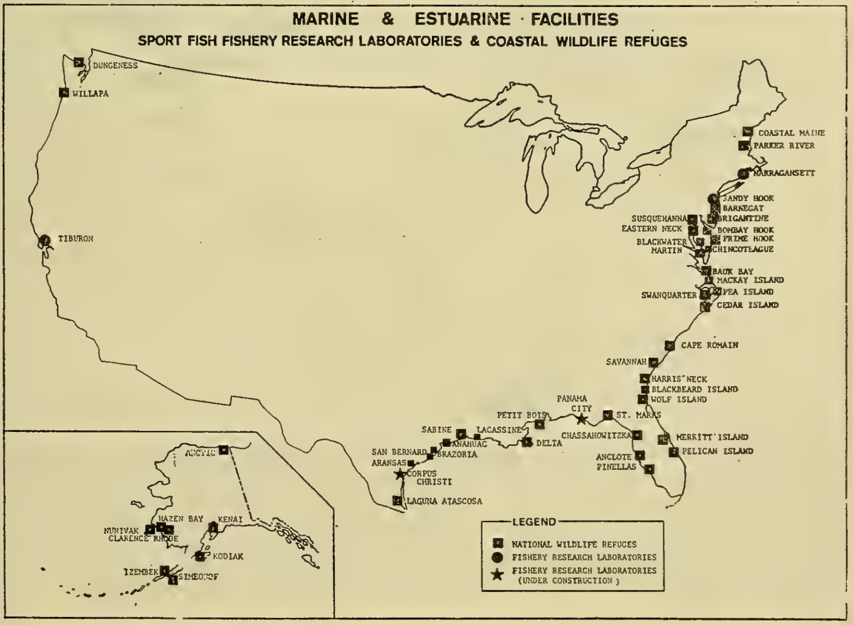
Major purposes	Fiscal year		
	1966	1967	1968
Fishery development and seafood technology:			
Fisheries resources assessment, development, and management	26.1	25.9	26.0
Technical and economic assistance to commercial fishing industry	11.9	17.4	20.3
Fish protein concentrate	.5	.5	1.7
Total	38.5	43.8	48.0
Marine pollution abatement and control: Water quality enhancement	2.6	4.1	5.7
Minerals/chemicals/water and energy resources:			
Geologic investigations and resource appraisal	1.0	2.2	2.5
Mining research	.4	1.4	1.4
Marine sources and interrelationships for supply of fresh water	1.7	2.9	3.4
Leasing and management of mineral resources	.1	.7	.9
Total	3.2	7.2	8.2
Recreation:			
Acquisition marine-based recreational areas	15.1	24.6	39.3
Development of marine areas for recreation	7.2	21.0	18.3
Conservation of marine locales, gamefish, and wildlife	6.0	5.6	8.3
Total	28.3	51.2	65.9
Multigoal activities: Education	.2	.2	.2
Total, major purposes	72.8	106.5	128.0

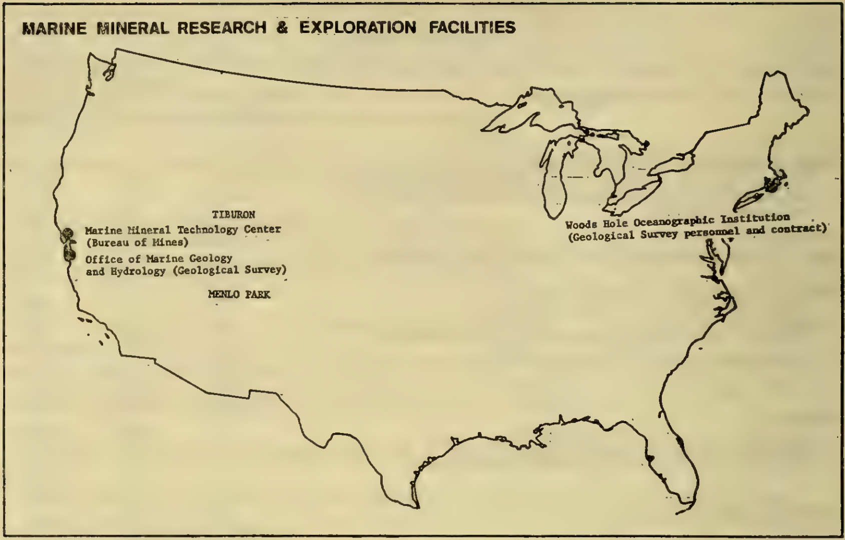
These figures will vary from those published by the Marine Science Council in its first report because of the inclusion of additional amounts of acquisition of marine-based recreational areas. The total level of expenditures expected in marine resource-related activities for fiscal year 1968 is $128.0 million.

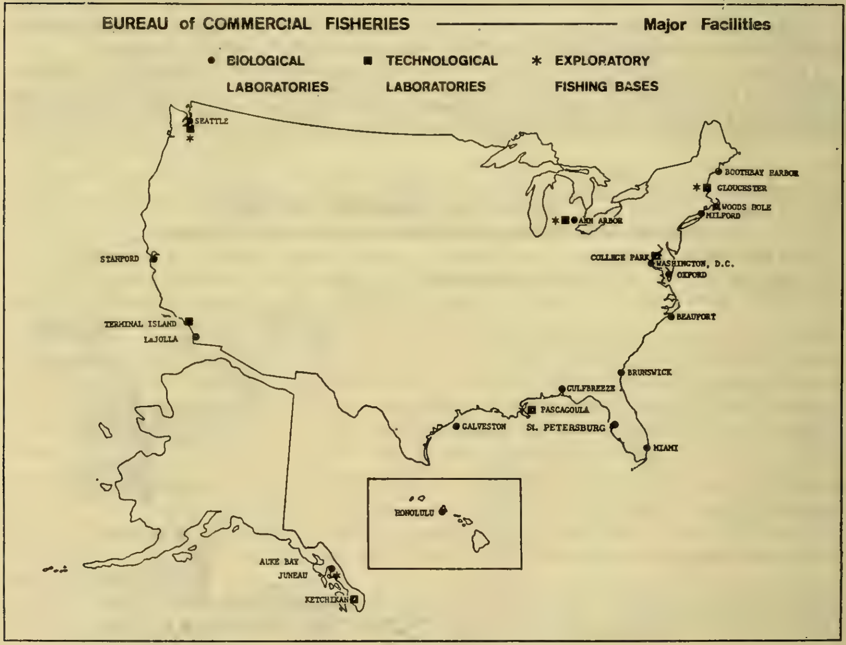
Through the cooperation of this and other committees of Congress the Department has been granted over the years a very substantial capability in marine resources, research and development. We have a staff of over 600 professional personnel in marine resource work. The Department operates 21 high seas ships

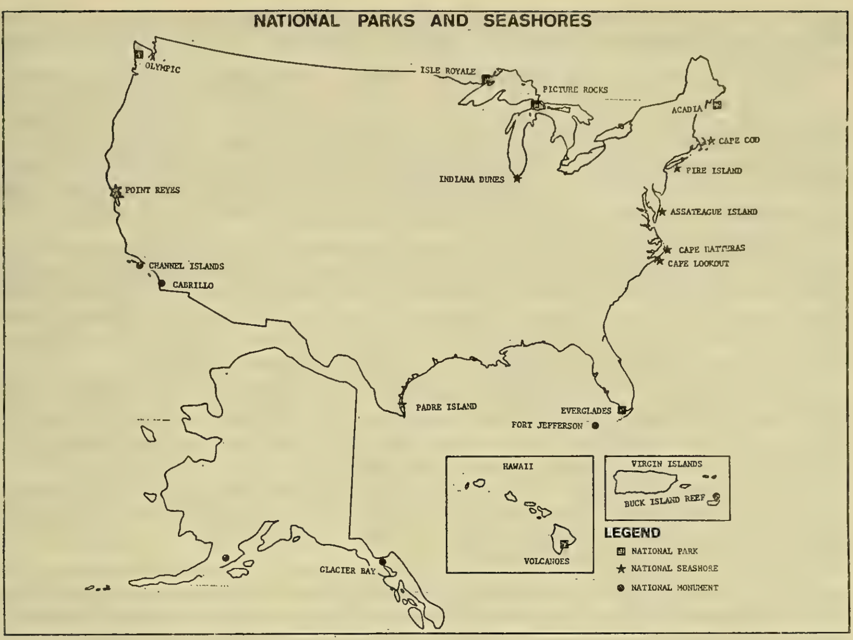
MARINE & ESTUARINE · FACILITIES

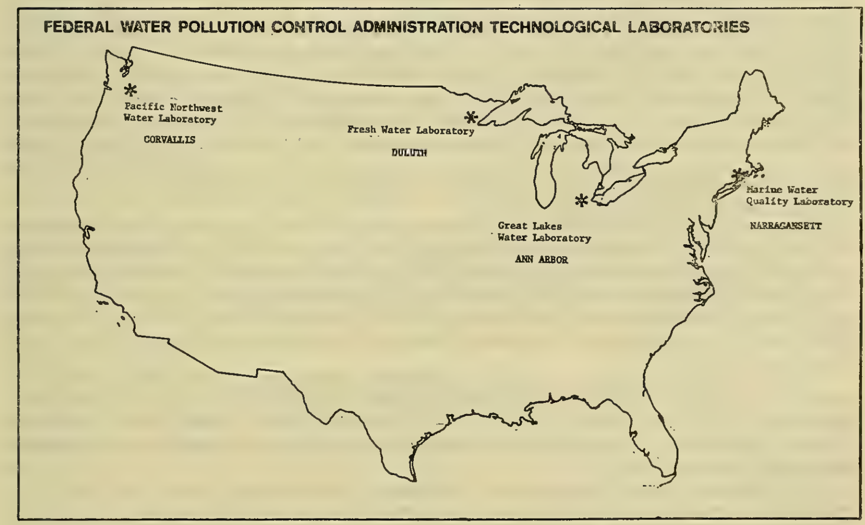
SPORT FISH FISHERY RESEARCH LABORATORIES & COASTAL WILDLIFE REFUGES


DUNGENESS
WILLAPA
TIBURON
COASTAL MAINE
PARKER RIVER
NARRAGANSETT
SANDY HOOK
BARNEGAT
SUSQUEHANNA
BRIGANTINE
EASTERN NECK
BOMBAY HOOK
BLACKWATER
PRIME HOOK
MARTIN
CHINCOTEAGUE
BACK BAY
MACKAY ISLAND
SWANQUARTER
PEA ISLAND
CEDAR ISLAND
CAPE ROMAIN
SAVANNAH
HARRIS NECK
BLACKBEARD ISLAND
WOLF ISLAND
PANAMA CITY
PETIT BOIS
ST. MARKS
SABINE
LACASSINE
ANAHUAC
DELTA
CHASSAHOWITZKA
MERRITT ISLAND
SAN BERNARD
BRAZORIA
ARANSAS
PELICAN ISLAND
ANCLOTE
PINELLAS
CORPUS CHRISTI
LAGUNA ATASCOSA
ARCTIC
HAZEN BAY
KENAI
NUNIVAK
CLARENCE RHODE
KODIAK
IZEMBEK
SIMEONOF
LEGEND
■ NATIONAL WILDLIFE REFUGES
● FISHERY RESEARCH LABORATORIES
★ FISHERY RESEARCH LABORATORIES (UNDER CONSTRUCTION)


MARINE MINERAL RESEARCH & EXPLORATION FACILITIES
TIBURON
Marine Mineral Technology Center
(Bureau of Mines)
Office of Marine Geology
and Hydrology (Geological Survey)
MENLO PARK
Woods Hole Oceanographic Institution
(Geological Survey personnel and contract)


BUREAU of COMMERCIAL FISHERIES — Major Facilities
● BIOLOGICAL LABORATORIES
■ TECHNOLOGICAL LABORATORIES
✱ EXPLORATORY FISHING BASES
SEATTLE
STANFORD
TERMINAL ISLAND
LaJOLLA
ANN ARBOR
BOOTHBAY HARBOR
GLOUCESTER
WOODS HOLE
MILFORD
COLLEGE PARK
WASHINGTON, D.C.
OXFORD
BEAUFORT
BRUNSWICK
GULFBREEZE
PASCAGOULA
GALVESTON
St. PETERSBURG
MIAMI
HONOLULU
AUKE BAY
JUNEAU
KETCHIKAN


NATIONAL PARKS AND SEASHORES
OLYMPIC
ISLE ROYALE
PICTURE ROCKS
ACADIA
CAPE COD
FIRE ISLAND
INDIANA DUNES
POINT REYES
ASSATEAGUE ISLAND
CAPE HATTERAS
CAPE LOOKOUT
CHANNEL ISLANDS
CABRILLO
PADRE ISLAND
EVERGLADES
FORT JEFFERSON
HAWAII
VIRGIN ISLANDS
BUCK ISLAND REEF
VOLCANOES
GLACIER BAY
LEGEND
NATIONAL PARK
NATIONAL SEASHORE
NATIONAL MONUMENT


FEDERAL WATER POLLUTION CONTROL ADMINISTRATION TECHNOLOGICAL LABORATORIES
Pacific Northwest Water Laboratory
CORVALLIS
Fresh Water Laboratory
DULUTH
Great Lakes Water Laboratory
ANN ARBOR
Marine Water Quality Laboratory
NARRAGANSETT

equipped for biological or geological oceanographic research and for marine mining and fishing engineering development. We have an extensive array of marine resource facilities including research and technological laboratories, national park and seashore areas and coastal wildlife refuges. Charts showing the locations of these various facilities are included here for your information.

Our time this morning does not permit an extensive description of Interior's total ongoing marine resource program. However, I would like to take this opportunity to mention some highlights of recent accomplishments or a brief description of program status to illustrate the scope of our marine resource activities.

Through the Bureau of Commercial Fisheries the nation is being furnished with technical knowledge which assists the exploitation and management of ocean and lake fisheries. Information has been produced on abundance, distribution, and behavior of the major exploitable fishery stocks available to the U.S. fishing industry. In many high seas situations, such as in the Northwest Atlantic and the North Pacific, cooperative research with other nations has furnished information to be used as a basis for management of fishery stocks that are of common concern to several nations.

There has been discovery of new stocks of shrimp south of the Aleutian chain and along the northeastern coast of South America. Largely untapped hake and anchovy resources have been described along the Pacific Coast. Predictions have been made on the availability of skipjack tuna in the Hawaiian Islands region and of albacore tuna in the Eastern Pacific, of shrimp in the Gulf of Mexico and scallops, menhaden and ground fishes in the Western Atlantic.

The members of this committee are well informed on the development of fish protein concentrate, the process which makes a nutritious fish additive from whole fish. The Bureau of Commercial Fisheries is now cooperating with the Marine Council and AID in making the technology for this process available to other countries where the need for protein is acute.

Progress has been made in estuarine research to determine the life histories of species that inhabit these productive waters and to interpret the effects which various engineering and other environmental alterations have on the survival of species that inhabit inshore waters.

The National Estuarine Study directed by the Clean Waters Restoration Act and being carried out by the Federal Water Pollution Control Administration will be of extensive help in the future to reach decisions on courses of action in estuarine areas. This three-year study and analysis of estuarine uses and problems will have a strong bearing on recreation, commercial fishing, transportation and other industrial interests.

Marine geological research and exploration have shown presence of fresh water aquifers 90 miles off Florida, structures which are likely to hold oil and gas resources on the Atlantic Continental Shelf, a major source of sand and gravel off New York and extensive pavement-like deposits of manganese on the Blake Plateau off the coast of Florida and Georgia. Marine phases of the Geological Survey and Bureau of Mines Heavy Metals Programs have shown gold in placer deposits in Norton Sound of Nome, Alaska. The black sand deposits off Oregon and California are being investigated for their potential heavy metal content. In mining research, progress has been made with specialized core-drilling devices as instruments to delineate the nature, structure and grade of sediment and sea bed mineral deposits.

Related to the discovery of mineral resources is the management of Continental Shelf lands. The Department has administered leases for oil, gas, sulfur and other materials which have brought over $2.7 billion to the Federal Treasury since 1954. The Geological Survey and the Bureau of Land Management are the agents for the Federal Government as designated by the Secretary of the Interior to manage the resources which are U.S. possessions in the submerged lands of the Outer Continental Shelf.

A nation-wide recreation plan is now being developed by the Bureau of Outdoor Recreation. It will analyze the demand, supply, needs, and opportunities for recreation on a national scale. The plan will make known the relation of marine and Great Lakes recreation to the total recreation complex in a manner not previously possible.

The National Park Service now maintains 20 lake and seashore areas that provided recreation and enjoyment for more than 7 million visitors in 1966. 82 national wildlife refuges located in coastal areas had 1.3 million recreational visitors in 1966. The Land and Water Conservation Fund has assisted 133 projects in states to acquire and develop recreational areas on the sea coast and on the Great Lakes.

The conservation, abundance and distribution of varied marine gamefish and wildlife species of marine interest are under study by the Department's Bureau of Sports Fisheries and Wildlife. In recent years 3 marine gamefish laboratories have been established and 2 new ones are now under construction on the Gulf Coast.

Future plans: Interior's goal in the future is to increase its ability to assist the nation to develop and use its marine resources to meet varied national needs. This calls for strengthening of present efforts and for extension of activities into new fields of endeavor.

Some needs are:

1. Development of a greater marine engineering competence within the Department. This would allow closer cooperation with industry and with other government agencies such as the Navy to take advantage of developments in undersea technology or instrumentation for resource applications.

2. More involvement with university-academic research. This will bring new top-level scientific talent to concentrate on science for resources. It will help ensure the supply of scientific manpower for this field in the future. On this subject Interior plans to continue in close cooperation with the Sea Grant College Program.

3. More involvement in international marine resource activities. Interior presently monitors the status of natural resource situations on a world-wide basis, including mineral, fuel and fishery commodities plus services, conservation and research activities. This work could be expanded and used further in the assistance of the Department of State, AID, industry and friendly governments of the world in furtherance of U.S. policies.

In concluding my remarks on Interior's marine resources and scientific activities we wish your committee to know that this field is receiving major attention from the Department. Our organizational structure, cooperation with others, and planning for the future is of concern to our top management team. We wish you to know also that the National Council and the Commission have our support, and that we are doing all we can to assist in their studies and to coordinate our activities with member agencies, contractors and others involved.

Concerning the Committee on Multiple Use of the Coastal Zone, I believe it most appropriate that the task of coordination of this aspect of the Marine Council's program be placed with Interior. As I have stated previously the Department has many programs in the estuarine and coastal zone which are of concern to compatible use of this area. For example, over past years we have worked under the authority of the Coordination Act to review projects of the Corps of Engineers, the Bureau of Reclamation and the Federal Power Commission for the purpose of making engineering projects compatible with fish and wildlife interests. The Committee will recall also that we have just recently completed an Agreement between the Secretary of the Army and the Secretary of the Interior on full cooperation and coordination in the control and prevention of water pollution and the conservation of natural resources in navigable waters of the Nation.

The term "multiple use" connotes the problems and opportunities which the Council's committee will study. Estuaries, shorelines, bays and the more immediate coastal areas are areas of intensive multiple use. There are shipping, fishing, waste disposal, land reclamation, mining, recreation of many kinds, dredging, filling, pipelines, telephone lines, flood control and many other activities. Federal, State and local governmental juridictions are concerned. Public, private, institutional and industrial sectors are involved. Ownership is private or public—but in some ways the coastal zone seems to be everyone's property, but not clearly anyone's responsibility.

According to the charge from the Vice President:

"This committee will be concerned with the broad areas of environmental planning, conservation and development including water pollution, based on studies and committee deliberation on problems identified by the committee or referred to it by the Council. Major programs to be coordinated through this committee include the multi-agency, multi-disciplinary Federal activities in the Chesapeake Bay system (and similar comprehensive studies), erosion control and shore development activities, channel and harbor development and redevelopment and other transportation functions in the shore zone, conservation of marine ecology and recreational development of marine areas, and pollution abatement and control in bays, estuaries and the Great Lakes. During FY 1968 the committee will monitor the major initiative identified as the estuary study (focused initially on the Chesapeake Bay)."

In explanation of the terms of reference, the committee is to analyze ongoing and planned activities of Federal agencies. Identify problems, deficiencies and needed reorientation or emphasis in the light of public needs. It is to undertake studies and submit recommendations to the Marine Council as designed, or it is to act on its own initiative. The areas of concern are environmental planning, conservation, and development, including water pollution. There is to be coordination, through the committee, of major programs of multi-agency, multi-disciplinary Federal activity. Miscellaneous subjects include erosion control, shore development activities, channel and harbor development, redevelopment, and and other transportation-related activities, conservation and marine ecology, recreational development of marine areas, pollution abatement and control in bays and estuaries and the Great Lakes.

Because the committee has been in existence a short time, its main work lies in the future. The task we are undertaking at the moment is a review of ongoing agency activities and plans for the immediate future so that we can obtain coordination of planning for fiscal year 1969. The specific subjects under review, in cooperation with consultants to the Marine Council staff are:

1. Marine pollution abatement and control;
2. Recreational activities;
3. Shore stabilization and protection; and
4. Channel and harbor development and protection.

Membership on the committee consists of representatives of those agencies involved with the Marine Council which have an interest in the coastal zone—for any purpose. A table showing the agency representatives as designated is attached here for your information.

COMMITTEE ON MULTIPLE USE OF THE COASTAL ZONE

Member	Title	Agency
Dr. Stanley A. Cain (chairman)	Assistant Secretary Fish and Wildlife, and Parks	Interior.
Mr. Donald L. McKernan	Special Assistant to Secretary for Fisheries and Wildlife.	State.
Alternate: Mr. Burdick H. Brittin	Deputy Special Assistant	Do.
Rear Adm. James C. Tison, Jr	Director, Coast and Geodetic Survey, ESSA	Commerce.
Rear Adm. Robert W. Goehring	Chief, Office of Operations, U.S. Coast Guard	Transportation.
Alternate: Capt. William Jenkins	Chief, Law Enforcement Division, U.S. Coast Guard.	Do.
Mr. Joseph E. Upson	Deputy Assistant Chief for Research and Technical Coordination, Water Resources Division, Geological Survey.	Interior.
Mr. James A. Lee	Assistant for Environmental Health to the Assistant Secretary for HEW.	Health, Education, and Welfare.
Dr. John N. Wolfe	Division of Biology and Medicine, AEC	Atomic Energy Commission.
Alternate: Mr. Walter G. Belter	Division of Reactor Development and Technology	Do.
Mr. Robert Abel	Director, national sea-grant program	National Science Foundation.
Alternate: Mrs. Josephine Doherty	Associate Program Director for Environmental Biology.	Do.
Dr. I. Eugene Wallen	Head, Office of Oceanography and Limnology	Smithsonian Institution.
Mr. Jack W. Carlson	Senior staff economist	Council of Economic Advisers.
Mr. Leonard Dworsky	(To be designated by the Office of Science & Technology.)	
Lt. Gen. Wm. F. Cassidy	Chief of Engineers, Corps of Engineers	Defense.
Alternate: Brig. Gen. Harry G. Woodbury.	Office of Chief of Engineers	Do.

At the occasion of our first committee meeting I prepared a statement on the Multiple Use Concept, which I hope will be a rationale for our guidance in the future. With your permission I would like to place these thoughts in the record. While they repeat somewhat my previous comments, I believe you will find them of interest.

COMMENT ON THE MULTIPLE-USE CONCEPT

Much of the phenomenal development of American economy has been accomplished by constantly improving technology applied to resource after resource, each treated as though it existed in nature more or less in isolation.

There is developing a new understanding. Leaders of industry and developers and administrators of natural resources, in private and public enterprises, are beginning to understand the complicated systems that compose nature. No natural resource—thing, condition, or process in the environment useful to man—is isolated in nature. Resources occur in intimate complexes. All are interacting to greater or lesser degree. What man does to one resource can have significant consequences for other resources, reducing or precluding their use.

The great environmental systems (air, water, land, life) interact. Each has a myriad of interacting subsystems. The analogy of an elastic web has been used. An impact will affect all parts of the web, but not with equal intensity nor, for man, significance.

The second understanding adds to the complexity of natural systems those of man's interests in them. There is scarcely a natural resource that has a single use only. Man's interests in natural resources vary according to their objectives. Because a resource may have many uses and because man's interests differ, not all possible uses can be realized simultaneously in the same place. Conflicts are an inevitable result. Resource use may be in economic terms, the use of a resource going to the highest bidder, or the allocation may be made in the political arena according to social judgments that may run counter to market economics.

A third alternative exists: Planned allocation to several uses with the incompatible ones separated in space or time. This is what is intended by the expression "multiple use." It is a valid concept that fits contemporary thinking about the environment in which we live and its resources whereby we live, but it has weaknesses as well as strengths. Of itself, the concept provides no answers to our problems. To some persons it seems to legitimize any use of the environment or a natural resource, to provide a right to do so anywhere. Acceptable uses must be planned for. Judgments and allocations among possible and desirable resource uses still have to be made despite the multiple use concept, or, perhaps, because of it, but in a different way than by laissez faire.

The temper of the time suggests that no one use or limited cluster of uses should prevail if other desirable uses are thereby precluded. It seems, therefore, that multiple use requires a planned allocation of resources guided by a concern for the general welfare.

The solution of this problem can take many forms guided by: 1) planning to separate desirable but incompatible resource uses in space or time, and 2) a mixed economy of public and private enterprise.

Mr. ROGERS. Our next witness is Dr. Sidney Galler, Assistant Secretary of the Smithsonian Institution. It is always a pleasure to have you.

STATEMENT OF DR. SIDNEY R. GALLER, ASSISTANT SECRETARY, SMITHSONIAN INSTITUTION; ACCOMPANIED BY DR. WILLIAM ARON, DEPUTY HEAD, OFFICE OF OCEANOGRAPHY AND LIMNOLOGY

Dr. GALLER. Thank you.

I would like to ask Dr. William Aron, Deputy Head of our Office of Oceanography and Limnology, to join me.

Mr. ROGERS. Very well. We will put in your full statement and you may highlight it as you wish.

Dr. GALLER. Mr. Chairman and distinguished members of this subcommittee, Secretary Ripley extends his profound regret at not being able to appear here, and has asked that I deliver the statement.

Mr. Chairman and gentlemen of the committee, the Smithsonian Institution was established in 1846 with a congressional charge to carry out activities for "the increase and diffusion of knowledge among men." It is highly appropriate for this series of hearings to request a a report on the actions of the Smithsonian which relate to oceanography, and for the Congress to consider the effectiveness of the Smithsonian in contributing to the national objectives in marine resources and engineering development.

As a basic research organization the Institution has pioneered in several research fields, contributing directly to the establishment of the Weather Bureau, the Bureau of Commercial Fisheries, the Geological

Survey, the National Advisory Committee on Aeronautics, and others. The first Assistant Secretary, and later Secretary, Spencer F. Baird, was the first Smithsonian oceanographer. During the late 1850's and early 1860's he directed his attention to the population fluctuations of fishes off the New England coast and spent his summers investigating the species and distribution of the fishes off the New England coast.

Our interest in ichthyology has been continuous since the time of Dr. Baird, Drs. Louis Agassiz, and David Starr Jordan. The Smithsonian Institution is the repository of one of the world's finest collections of marine organisms ranging from algae through clams and fishes to whales, both fossil and recent, which have made the Institution a mecca for scientists engaged in research on marine organisms.

Our interest in marine geological specimens also dates from the original Smithsonian Institution Act when the Congress provided that all rocks, minerals, geological, and biological specimens collected by any U.S. Government agency and brought into the District of Columbia shall belong to the Smithsonian Institution. As reaffirmed and broadened by the Geological Survey Act of 1879, the reference to the District of Columbia was eliminated. We have substantial geological collections of rocks, minerals, and sediments.

The Smithsonian Institution's contributions to biological oceanography has been recognized by numerous national committees entrusted with the task of developing a U.S. national program in oceanography. For example, the National Academy of Sciences report entitled "Oceanography 1960 to 1970" states "Many lines of marine research depend upon precise definition of species. The study of species is centered in research museums which generally have been supported very poorly. It is recommended that established museums having significant study collections be given financial support so that this kind of work can be carried forward."

In December 1962 an advisory committee consisting of scientists from universities, private oceanographic groups, and Government agencies, chaired by Dr. Milner B. Schaefer, now science adviser to the Secretary of the Interior, met to review the role of the Smithsonian in the national oceanography program, and in their January 2, 1963, report concluded:

> The responsibility of the Smithsonian Institution to the National Oceanographic Program should be, in consultation with other appropriate agencies, to carry out, or arrange for, the preservation and study of collections of materials made by Federal agencies, and of other collections which may be referred to the Institution. These will include both biological and geological materials, but will not ordinarily include water samples. Collections made by other Federal agencies for their own research programs should come to the Institution when no longer needed for investigations in progress.
>
> Collections will come from three sources:
>
> (1) From the routine collections made as part of the world ocean survey.
>
> (2) From research cruises and expeditions of other agencies. Inasmuch as a large part of such collections will be made for specific research objectives of other agencies, they will, in general be studied by them before permanent transfer to the Smithsonian. Other collections may be deposited immediately with the Smithsonian, at the discretion of the collecting agency.
>
> (3) Collections by personnel of the Institution, either aboard ships operated by ithers, or from vessels operated by the Institution. The latter should primarily be to fill in gaps in knowledge not otherwise properly obtainable.
>
> With regard to collections made under (1) and (2), the Institution, should, when feasible, participate in the planning of the operations, and, where its

> own personnel are not aboard to act or advise in collecting operations, should provide instructions for proper handling and preservation of collections, so that they will be of maximal scientific value.
>
> The Institution should continue its policy of employing and supporting specialists in other institutions, especially where the work to be done is such as to require only part-time effort.
>
> Adequate study of some materials collected by the oceanographic program will require study of related materials from freshwater and land.
>
> The responsibilities of the Smithsonian Institution in relation to the National Oceanographic Program, will require large increases in its oceanographic budget. During the next decade its professional staff for the oceanographic program should increase by about 125 people, with at least an equal number of technical assistants, and necessary clerical and other supporting services For salaries, expenses, supplies, and normal equipment for their support the annual budget (in 1962 dollars) at this level would be about \$4 x 10^6. Capital investment fir construction of space to house these people and the collections, and for space for visiting investigators, and for special equipment will amount to about \$3 x 10^6 to \$5 x 10^6, depending on whether new or converted structures are utilized.
>
> Funds will also be required for vessel charter, for special collections by the Museum staff, for support of contracts with other institutions, for investigations at other museums (both foreign and domestic), for scholarships and fellowships, and for the sorting center. Such funding would be in addition to the amounts suggested.

In their 1965 report, "Industry and the Ocean, Continental Shelf," the Ocean Science and Technology Advisory Committee of the National Security Industrial Association recommended that—

> The Smithsonian Institution should be responsible for the processing, storage, and distribution of all geological, biological specimens resulting from the National Oceanographic Program.

A report, "Effective Use of the Sea," was issued in June 1966, by the Panel of Oceanography of the President's Science Advisory Committee. It makes the following statements:

> Recommendations with regard to marine biology affect both the long-range goal of increasing marine food resources and preserving the near-shore environment. Specific recommendations are:
>
> 1. Intensive multidisciplinary studies of biological communities in marine habitats subject to human influence and exploitation. Such studies should include estuaries and the continental shelf. A very important, special case is the proposed sea level canal to join the Atlantic and Pacific Oceans.
> 2. Establishment of marine wilderness preserves to provide a baseline for future studies.
> 3. Construction of facilities needed for studying organisms in special marine environments such as the deep sea and tropics.
> 4. Increased encouragement and support of identification and use of marine organisms as tools for biomedical research and as potential sources of drugs.
> 5. Establishment of a national center for collection, maintenance, and distribution of living marine organisms for use in marine and biological research.

In answer to this report, we now have acquired a tract of approximately 900 acres of land bordering on the western shore of the Chesapeake Bay, and it is our intention in concert at present with two universities, the Johns Hopkins University and the University of Maryland, to develop a long-term program of what we call baseline estuarine ecology where scientists can join together and over an extended period of time begin to ascertain some of the fundamental dynamics in the interchanges between the land mass and a very unstable body of water that we usually call an estuary.

Unless we establish this kind of, shall we call it baseline, ecology or ecological frame of reference, unless we do establish this fundamental body of knowledge, it will always be difficult to ascertain when the estuaries are beginning to undergo some deleterious change as a result of man's influence. So if we do have a baseline of information available, we can then begin to assess the kind and degress of changes that may be occurring.

The Smithsonian Institution, and particularly its oceanography program, might be likened to a kind of national reference library. Within the Smithsonian Institution, there are presently 70 marine-oriented scientists among our faculty; the combination of a national collection and the intellectual resources provide a kind of national referral center that can be utilized by members of the scientific comunity whether they reside in academic institutions or within the Federal R. & D. agencies.

I am sure you all recognize there are approximately 500,000 species of aquatic plants and animals that we know about. And I am pleased to say that within the Smithsonian Institution collection the vast majority of those species are represented in our reference collection, including "types" of species where the specimens, along with the ancillary data that has been gathered, provide a national reference resource for scientists and technologists.

I should also say that the identification of organisms is a most time-consuming chore and collection-oriented institutions throughout the country and the world have two imperative problems. One, how do we go about replenishing the very limited supply of systematists and taxonomists who have to make use—and forgive my jocular statements—of their Mark I eyeballs and Mark I brains to carefully, assiduously identify and classify these organisms so they can be used by scientists and technologists aiming at exploiting the resources of the sea.

Unfortunately, this time-honored profession of taxonomy is not one of the so-called popular sciences of today. Nonetheless, as our national aspirations in oceanography go forward, if they are to be realized, we must have an increased intellectual resource in taxonomy to provide basic descriptive marine biological and limnological information. At the same time we must realize that the need is increasing, but that the training of systematists is falling further and further behind.

In toto, our science-oriented museums represent the principal resource for taxonomists, for the training of taxonomists and for the training of technicians to assist in this time-consuming chore of identification.

Without going into great detail, I should like to highlight some of the things the Smithsonian Institution is presently engaged in, in this broad area we call oceanography.

One, in response to recognition of the need to produce more taxonomic information, and to produce it more rapidly, the Smithsonian Institution established in December 1962 the Smithsonian Oceanographic Sorting Center. The Smithsonian Oceanographic Sorting Center is essentially a kind of national resource for the collection, preservation, processing, and ultimately, identification of marine organisms, the results of which are then distributed to scientists and technologists throughout the country and throughout the world.

In the process of implementing the SOSC, as we call the sorting center, there has been a very fortunate byproduct. Recognizing that the numbers of technologists who are capable of doing this work are exceedingly limited, Dr. Wallen, the head of the Office of Oceanography and Limnology, and directly in charge of the sorting center, and his colleague, Dr. Aron, have instituted a technician training program.

One of the fortunate byproducts of this program is that when the technicians are trained, recognizing that the salary base in the Smithsonian Institution for technicians leaves something to be desired, they are encouraged to disperse and join other organizations, both universities and museums. Thus, through the sorting center, the Smithsonian Institution is facilitating the training and the relocation of technicians who in turn will replicate and provide at least part of the base technical support we need if we are really going to go forward with our national oceanographic program.

I believe the record will show that some 45 technicians out of a total of 80 have joined other organizations after having been trained in the Smithsonian Institution.

Another interesting facet concerns the Smithsonian Navy, the ship we call the *Phykos*, our one and only oceanographic research vessel, which some of my colleagues facetiously kid me about, by saying that they believe she spent more time at the Washington Navy Yard than at sea, and I suppose there is something to be said for that by virtue of our limited resources.

However, the *Phykos* is presently engaged in what we consider to be a unique educational experiment. The Smithsonian Institution has entered into an agreement with the Southern Maine Vocational Technical Institute that will enable the institute to make use of the *Phykos* for the training of some of their technicians. Their training program will occur in the fall and in the spring and, in return for that, these technicians will participate with our scientists in actual research expeditions for the gathering of information and the collection of specimens. So they will be getting field training and the Smithsonian Institution will be gaining the benefits of having a crew of trained oceanographic technicians available to its faculty.

Another development concerns the establishment of a satellite sorting center in Salammbo, Tunisia. Recognizing that in spite of our best efforts the need for identification is outstripping our capability of providing for this need, especially in dealing with certain groups of organisms located in various regions of the world where we do not have the expertise, the Smithsonian Institution has entered into an agreement with the National Oceanographic Institute in Tunisia for the establishment of an auxiliary sorting center for the Mediterranean area, and although the center has been in existence for something less than 1 year, the flow of marine material is becoming more and more facile.

We are entering into a number of subagreements with scientists throughout the Mediterranean area to participate in the identification of materials and I hope in this way the flow of taxonomic and ecological information into the international oceanographic community will be greatly facilitated.

Perhaps one of the most exciting opportunities confronting the Smithsonian Institution concerns itself with the research ships of opportunity. This is a concept, and I think a very viable concept, of making use of our merchant marine, the something over 700 platforms we have plying all of the oceans of the world to participate in the gathering of oceanographic information and in the collection of marine biological and geological materials.

A number of experiments have been carried out that suggest that this is a practical, feasible, and economical way of gathering oceanographic information, thereby relieving some of our limited number of research ships to carry on with fundamental research assignments rather than to be bogged down by routine surveys.

I should say parenthetically, Mr. Chairman, that this committee and its staff has been largely instrumental in bringing the research ships of opportunity concept into the forefront.

The Smithsonian Institution hopes to make use of this concept and in fact is presently negotiating with the Grace Line in the expectation that some time early next year we will be able to field a party of Smithsonian scientists and engage in survey work from one of their ships.

The fact remains, however, that, even though the Navy has pioneered in the development and use of this concept, there is yet to be a full-blown program that makes optimum use of our commercial ships for oceanographic research, and I would hope the day would come when some organization, either public or private, would assume the responsibility for providing the necessary instrumentation development and assorted requirements that would make this a really viable practical operation.

I should also say, as one of our highlights in terms of our contribution to marine biology and oceanography, the Smithsonian Institution since the early forties has been responsible for the management of the Barro Colorado Island biological area which recently has extended its activities and is presently called the Smithsonian Tropical Research Institute. Located in the Canal Zone, it has since 1925 provided a tropical niche for scientists engaged in investigating the biota in the tropics.

Barro Colorado Island is a preserve and in many ways it could be likened to the Smithsonian's national collection of research specimens. Only in this case, instead of maintaining a national collection of preserved material, it is a collection of unique tropical flora and fauna on the island which permits scientists again to develop baseline ecology that will serve us well as we go more and more into the tropics, from the political and the economic point of view.

Most recently the Smithsonian Tropical Research Institute established two small marine laboratories, one on the Caribbean side of the Panama Canal and one on the Pacific side. These laboratories are engaged in studies of the genetics of certain marine organisms and Dr. Rubinoff, who is our marine biologist in charge of those laboratories, is presently concerned with determining if species of organisms, certain fishes on the Caribbean, can hybridize, can mate and produce viable offspring when mated with similar species or related species on the Pacific side.

Our preliminary data suggests they can hybridize and this I suggest has some very profound implications in terms of what ecological changes in the ocean might be produced if there is a connection made between the two oceans.

The Smithsonian Institution is also participating in the use of some of our more modern submerisibles, especially those that have lockout capability. There are two reasons for this:

One, our marine biologists are very much interested in closeup examination of the living flora and fauna on location instead of having to depend almost exclusively on dredging and netting operations to determine what actually happens. Therefore, visual observations over an extended period of time, that are becoming available through some of the new submersibles, offer exciting opportunities for advancing our knowledge of the ecology of the seabed and the waters above it.

Also, we are making use of, and hope to make more use of, these modern submersibles for underwater archeological research. Many of the archeological theories about past occurrences relate to our understanding of oceanic dynamics. I cite the lost continent of Atlantis, not as a serious program for the Smithsonian, but merely to epitomize or to show the relationship between an improved understanding of underwater archeology and some of the current theories on oceanographic changes.

We plan to convene a small group of eminent marine archeologists from around the world in the near future and hope to develop and field a program of marine archeology that will extend our knowledge of ancient occurances in certain areas presently under water.

I believe, Mr. Chairman and members of the committee, this is a representative group of highlights of what we are doing.

(Prepared statement of Mr. Ripley follows:)

STATEMENT OF S. DILLON RIPLEY, SECRETARY, SMITHSONIAN INSTITUTION

Mr. Chairman and Gentlemen of the Committee:

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As a basic research organization the Institution has pioneered in several research fields, contributing directly to the establishment of the Weather Bureau, the Bureau of Commercial Fisheries, the Geological Survey, the National Advisory Committee on Aeronautics, and others. The first Assistant Secretary, and later Secretary, Spencer F. Baird, was the first Smithsonian oceanographer. During the late 1850's and early 1860's he directed his attention to the population fluctuations of fishes off the New England coast and spent his summers investigating the species and distribution of the fishes off the New England coast.

Our interest in ichthyology has been continuous since the time of Dr. Baird, Drs. Louis Agassiz, and David Starr Jordan. The Smithsonian Institution is the repository of one of the finest collections of marine organisms ranging from algae through clams and fishes to whales, both fossil and recent, which have made the Institution a mecca for scientists engaged in research on marine organisms.

Our interest in marine geological specimens also dates from the original Smithsonian Institution Act when the Congress provided that all rocks, minerals, geological and biological specimens collected by any U.S. government agency and brought into the District of Columbia "shall" belong to the Smithsonian Institution. As reaffirmed and broadened by the Geological Survey Act of 1879, the reference to the District of Columbia was eliminated. We have substantial geological collections of rocks, minerals, and sediments.

The Smithsonian Institution's contributions to biological oceanography has been recognized by numerous national committees entrusted with the task of developing a U.S. national program in oceanography. For example, the National

Academy of Sciences report entitled, "Oceanography 1960 to 1970" states "Many lines of marine research depend upon precise definition of species. The study of species is centered in research museums which generally have been supported very poorly. It is recommended that established museums having significant study collections be given financial support so that this kind of work can be carried forward."

In December 1962 an advisory committee consisting of scientists from universities, private oceanographic groups and government agencies (chaired by Dr. Milner B. Schaefer, now Science Advisor to the Secretary of the Interior) met to review the role of the Smithsonian in the National Oceanography Program, and in their January 2, 1963, report concluded:

"The responsibility of the Smithsonian Institution to the National Oceanographic Program should be, in consultation with other appropriate agencies, to carry out, or arrange for, the preservation and study of collections of materials made by Federal agencies, and of other collections which may be referred to the Institution. These will include both biological and geological materials, but will not ordinarily include water samples. Collections made by other Federal agencies for their own research programs should come to the Institution when no longer needed for investigations in progress."

"Collections will come from three sources:

(1) From the routine collections made as part of the world ocean survey.

(2) From research cruises and expeditions of other agencies. Inasmuch as a large part of such collections will be made for specific research objectives of other agencies, they will, in general be studied by them before permanent transfer to the Smithsonian. Other collections may be deposited immediately with the Smithsonian, at the discretion of the collecting agency.

(3) Collections by personnel of the Institution, either aboard ships operated by others, or from vessels operated by the Institution. The latter should primarily be to fill in gaps in knowledge not otherwise properly obtainable.

"With regard to collections made under (1) and (2), the Institution, should, when feasible, participate in the planning of the operations, and, where its own personnel are not aboard to act or advise in collecting operations, should provide instruction for proper handling and preservation of collections, so that they will be of maximal scientific value.

"The Institution should continue its policy of employing and supporting specialists in other institutions, especially where the work to be done is such as to require only part-time effort.

"Adequate study of some materials collected by the oceanographic program will require study of related materials from freshwater and land."

"The responsibilities of the Smithsonian Institution in relation to the National Oceanographic Program, will require large increases in its oceanographic budget. During the next decade its professional staff for the oceanographic program should increase by about 125 people, with at least an equal number of technical assistants, and necessary clerical and other supporting services. For salaries, expenses, supplies, and normal equipment for their support the annual budget (in 1962 dollars) at this level would be about $4 x 10^6$. Capital investment for construction of space to house these people and the collections, and for space for visiting investigators, and for special equipment will amount to about $3 x 10^6$ to $5 x 10^6$, depending on whether new or converted structures are utilized.

"Funds will also be required for vessel charter, for special collections by the Museum staff, for support of contracts with other institutions, for investigations at other museums (both foreign and domestic), for scholarships and fellowships, and for the sorting center. Such funding would be in addition to the amounts suggested."

In their 1965 report, "Industry and the Ocean, Continental Shelf," the Ocean Science and Technology Advsiory Committee of the National Security Industrial Association recommended that: "The Smithsonian Institution should be responsible for the processing, storage, and distribution of all geological, biological, specimens resulting from the National Oceanographic Program."

A report, "Effective Use of the Sea," was issued in June 1966, by the Panel of Oceanography of the President's Science Advisory Committee. It makes the following statements:

"Recommendations with regard to marine biology affect both the long-range goal of increasing marine food resources and preserving the near-shore environment. Specific recommendations are:

1. Intensive multidisciplinary studies of biological communities in marine habitats subject to human influence and exploitation. Such studies should include estuaries and the continental shelf. A very important, special case is the proposed sea level canal to join the Atlantic and Pacific Oceans.

2. Establishment of marine wilderness preserves to provide a baseline for future studies.

3. Construction of facilities needed for studying organisms in special marine environments such as the deep sea and tropics.

4. Increased encouragement and support of identification and use of marine organisms as tools for biomedical research and as potential sources of drugs.

5. Establishment of a national center for collection, maintenance, and distribution of living marine organisms for use in marine and biological research.

In its report the Panel recommended that the Smithsonian Institution fulfill its major obligation to systematic biology.

The first report of the President to the Congress on Marine Resources and Engineering Development, "Marine Science Affairs—A Year of Transition," has a table (Table I) on Federal agencies having marine science activities. This table lists the missions of the Smithsonian Institution as "Identification, classification, and ecology of marine organisms; investigations of the geophysical factors of oceanic environment." The report mentions Smithsonian contributions to Council initiatives and goals on Food From the Sea (page 49, 56), Estuary Study (page 33, 73). Continental Shelf (page 78, 115). Multi-goal Research (page 107), Oceanographic Data (page 108), and Excess Foreign Currency Projects (page 116).

The latest published survey of National Oceanographic efforts, "Oceanography 1966, Achievements and Opportunities," was published in 1967 by the National Academy of Science as a report of the Committee on Oceanography. On page 148 this report states:

"The housing of working reference collections of biological specimens present problems. Species range in size from those so small that they can be studied only with an electron microscope, to those whose individual specimens may weigh 90 tons or more. Although it is not practical to store the very small and fragile, and the very largest specimens, the vast majority need adequate facilities for the accumulation of materials awaiting study by a specialist and for the permanent storage of reference specimens. These facilities are properly the function of national museums and are being handled well by the U.S. National Museum of the Smithsonian Institution within the limits of its funds. We recommend that funds for this purpose be made adequate to the need."

The Smithsonian Institution's marine interests are what might be called collection-oriented. The objectives of our marine studies are: (1) to learn about the kinds, distributions and populations, of biological and geological materials in the oceans; (2) to establish the identities of fossil and recent marine organisms and sediments; (3) to participate in and contribute supplies for oceanographic expeditions to oceanic areas from which present information is inadequate; and (4) to assist scientists in carrying out collection-related research.

Our activities are varied and based on the scientific interests of the 60 scientists (46 full time) and 70 supporting staff members who devote most of their research efforts to marine-related scientific problems. The Smithsonian Institution's research program includes investigations of the planktonic, benthic and the nektonic organisms which occur from the surface of the sea to the spaces between sediments of the ocean floor. Our scientists' activities range from the Arctic through the Atlantic, Pacific and Indian to the Antarctic Oceans. They investigate the shallow waters of the Continental Shelf and estuaries as well as the deepest parts of the open ocean.

These investigations gather the information for dissemination by publication in the scientific literature. The specimens are incorporated into the national collections and are used in research by hundreds of marine scientists throughout the world. Scientists of all countries with an interest in marine resources come to the Smithsonian Institution to study with our staff and make use of the national collections.

We maintain a very large number of "type" specimens, serving as a kind of "Bureau of Standards" for the identification of organisms—500,000 species of aquatic plants and animals are represented. In addition to our staff we have direct, or exchange, agreements with major institutions throughout the world to facilitate identifications. We exchange specimens with all major world museums and also assist public and private scientific organizations and scientists of many nationalities with their research.

Identification of organisms is a most time-consuming chore. Marine organisms are so poorly known that a sizable percentage of the samples obtained contain undescribed or poorly known species. Smithsonian scientists provide assurance that these organisms are appropriately described for future reference. With this in mind we receive and process collections deposited by all Federal agencies engaged in marine research and development activities.

For example, through the Smithsonian Institution's Oceanographic Sorting Center abundances of fish larvae and eggs are reported to the Bureau of Commercial Fisheries. The Atomic Energy Commission and the Office of Naval Research receive reports from the investigations conducted at Bikini Atoll in 1946 to serve in establishing a baseline of marine biological activity prior to the nuclear tests. The National Institutes of Health has requested that we look for neoplasms in invertebrates and cold-blooded vertebrates as a part of the NIH campaign to study the eteology of neoplasms. For the Naval Oceanographic Office we have arranged for identification of special collections taken from the sound-scattering layer in the ocean. For the U.S. Antarctic Research Program of the National Science Foundation we arrange for specialists to identify and publish on certain groups of marine specimens. We identify special groups for the Environmental Science Services Administration, the Coast Guard and the Department of State.

In order to solve problems of identification, Smithsonian scientists borrow specimens from other museums whenever necessary. Rare and unique specimens not available on loan must be studied at their location in museums, and travel to such museums is required for our scientists. In cases where available specimens are too few to permit adequate study, Smithsonian scientists go to the field and attempt to collect additional specimens.

For example, on one trip to Madagascar a scientist found 15 new species of starfishes and 45 new species of copepod parasites in less than a week during collection of this one host-parasite group. Because adequate field observations and proper preservation in the field are of critical importance, our scientists frequently participate in oceanographic expeditions. Ships of many nations and of various U.S. agencies invite our scientists to join their cruises.

Thus, 14 scientists from the Smithsonian participated in the International Indian Ocean Expedition, two scientists in the International Cooperative Investigations of the Tropical Atlantic, two in the Guinean Trawling Survey, and more than 20 in the U.S. Antarctic expeditions. Our research results aid in the evaluation of biological resources, and productivity, the assessment of pollution damage, studies of drugs and chemicals of a biological origin, identification of water masses, as well as in the predictions of marine biological deterioration, bioluminescence, and in the assessment of hazards from predatory animals such as sharks. Smithsonian geologists recently have collected marine sediments off Argentina, Canada, Puerto Rico and the Eastern United States. They have studied the marine rocks of the mid-Atlantic Ridge in cooperation with the Woods Hole Oceanographic Institution and the Scripps Institution of Oceanography. They are curating and studying the test cores obtained during the now defunct Project Mohole.

Smithsonian scientists are encouraged to cooperate with universities so that they can direct graduate students in fields of their competence. About 16 universities, including George Washington University, the University of Maryland, Johns Hopkins University, the University of Kansas, have entered into cooperative agreements with the Smithsonian to facilitate research and education.

The Smithsonian Institution operates an oceanographic research ship called PHYKOS. PHYKOS is a vessel of 650 tons, full load displacement. Well suited for coastal work, she was used in fiscal year 1966 for research on coralline algae from Newfoundland to the Florida coast. She also served as a support vessel for familiarization dives of two underseas vehicles, ASHERAH and Cubmarine (PC–4).

More recently, an agreement was reached whereby PHYKOS will be used jointly with the Southern Maine Vocational Technical Institute in Portland, Maine. Under the initial one year agreement PHYKOS will be used during the fall and spring school terms for student training. PHYKOS will continue to be available for our own research during the other seven months of the year. The school will provide full support for local research cruises and will assist the Smithsonian in crewing the vessel during our field expeditions.

Within the last few years more than 35 ships of 21 U.S. and foreign organizations have been used for more than 100 cruises by members of the Smithsonian staff. In addition, Smithsonian scientists have made more than 50 dives on 9 underseas vehicles.

The Smithsonian helped organize a marine biological program for the Environmental Science Services Administration vessel, OCEANOGRAPHER, during several legs of its round-the-world cruise.

The Smithsonian Institution is giving careful consideration to the use of merchant ships as oceanographic survey platforms for studies of ocean productivity on a synoptic basis. For several years the Navy and other agencies have utilized ships of the Merchant Marine as so-called Research Ships of Opportunity to gather data in support of their missions. Three experiments were carried out by oceanographic groups under ONR auspices to establish the feasibility of the use of merchant ships for biological data collection. Although the demonstrations were quite successful, no mechanism has yet been established in the Federal Government to fully develop the research potential of Ships of Opportunity.

The Smithsonian Institution has had discussions with a representative of Grace Line to consider the use of their ships in a special research project to begin in January. We hope that this will eventually lead to a national program of collection of biological data from merchant ships. Certain cruises of these vessels pass the same open ocean area on a regularly scheduled basis. They offer an opportunity to study short term changes in the oceanic environment. This program could strongly augment the National oceanographic effort by providing many reliable and inexpensive research platforms for conducting oceanographic surveys which are presently being conducted by the specialized oceanographic research ships. The research ships should be freed for high priority research assignments.

Ultimately, the success of the Ships of Opportunity program will depend upon a capability for handling large volumes of data, and processing large numbers of specimens, both biological and geological. No single organization can handle such a program at present, and this, perhaps, is the major reason why it has not been fully developed. It seems clear to us, however, that the Ships of Opportunity program must be facilitated and the Smithsonian Institution is ready to assist in every way appropriate.

Although modern experience and the impetus for utilization of underseas vehicles for research really began with the 1959 dive of TRIESTE to 35,700 feet depth in the Marianas Trench, biologists have attempted to observe organisms by surface-supported diving in the sea at least since 1844. During the last several years the Smithsonian Institution has made a significant commitment of our scientist-resources to underseas research. Many of our scientists have adopted SCUBA techniques, and are employing these techniques routinely in their biological and geophysical investigations.

The first research submersible vehicle was used by the Smithsonian Institution in 1964. Since then, such dives have established the fact that underseas vehicles are quite useful in facilitating our research programs.

For example, submersibles are being used to study the distribution of Coralline algae. These reef-forming plants help to consolidate the sediments and stabilize the coastlines of the eastern United States in areas north of the coral reef communities. Coralline algae may be of great significance in the production of organic matter in the shallow water areas. There does not exist a reliable estimate of the depth limitations to their occurrence. Diving vehicles will extend our knowledge in depth and to seaward.

Smithsonian scientists are concerned with the study of mid-water organisms (in the upper waters of the deep ocean). These populations are of interest as potentially exploitable fisheries. Also, they scatter sound. Their specific identities are controversial. They are variously reported to be fishes, squid, jellyfish, shrimp, siphonophores, and other organisms. Our scientists are eager to use the capability of underseas vehicles to study the kinds, distributions, and populations of mid-water organisms.

Geological theories of the origin of continents and their changing faces with time are deeply involved in shore processes. Smithsonian geologists use SCUBA to study the formation of underseas canyons. Drastically limited by diving techniques, these scientists urgently need vehicle time to follow the underseas contours, observe the physical features, and sample in specific locations. Rocks dredged from the ridge on the floor of the middle Atlantic Ocean indicate that enlightening information on the structure and movement of the Earth's crust could be gathered by deep diving vehicles. With chartered underseas vehicles, the Smithsonian plans to make detailed studies of this poorly studied but promising geological area.

Two program areas of particular interest would employ research submersibles with lock-out capabilities. With the development of saturation diving techniques and submarines which may be equalized to ambient pressure in the shallow ocean, it has become possible for scientists to work exposed to the ocean environment for extended periods at depths up to at least 150 meters. Man himself is the most versatile scientific tool, and this ability to work in the hostile oceanic milieu is an important step forward in the efforts to explore and to understand the sea.

The first program area involving lock-out vehicles combines detailed observations of the distribution and abundance of the ocean biota with *in situ* experiments. Work has been performed in evaluating the influence of light on animal behavior and new observations have been made on the mating of cephalopods in a natural environment. The experimental work must be extended to examine various frequencies and intensities of light and also into other areas of research. Our knowledge of oceanic animals is sufficiently sparse so that practically any observation that is made represents a significant extension of data.

As a second program the use of lock-out vehicles provides a major tool for extending archeological knowledge. The recent field of submarine archeology has already provided new insight into the past. With the use of submersibles, submarine archeological research will be greatly facilitated.

Another area of prime interest to the Smithsonian Institution is the Eastern Pacific and the Caribbean on either side of the Isthmus. Under the auspices of the Atlantic-Pacific Interoceanic Canal Study Commission, studies are presently underway to determine the engineering feasibility of a trans-isthmian sea level canal. Such a canal, connecting the oceans across the Isthmus, would provide a unique opportunity for scientific study of the ecology of the region and any detectable changes thereto which may accompany this project.

Well aware of the long time between the construction of the access canal from the ocean to the Great Lakes and the appearance of the sealamprey and the marine alewife fish as pests in the Great Lakes, the Smithsonian Institution has been concerned for several years that adequate baseline ecological investigations be undertaken before construction of any sea level canal. Scientists at the Smithsonian Tropical Research Institute have already discovered that certain related species of fishes from the Atlantic and Pacific Oceans can be hybridized in the laboratory.

Extrapolating from the observed morphological diversity, we can expect that, after the sea level canal is completed and the barrier to dispersal is removed, a wide range of changes may occur. The influx of new organisms might upset the balance of some populations of marine organisms. Instances of hybridization and intergradation can be predicted among those related groups from opposite sides of the Isthmus which have not accumulated sufficient genetic or behavioral isolating mechanisms. In some circumstances competition between newly mixed elements of the biota may cause rapid changes in population densities. Some species may become more abundant, while others may become extinct. New species interrelationships could occur. The possible effect on harvestable marine species is uncertain.

As established during the Smithsonian Conference on Tropical Biology held in Panama City, November 10–12, 1966, our knowledge of tropical marine biology lags far behind parallel information in the temperate regions. Accumulation of data for tropical regions is essential for the development of rational programs to harvest the sea and to utilize its resources. The major areas of protein deficiency for human populations are in the tropics. Detailed knowledge of the potential fisheries resources is but one of the side benefits to be anticipated from the proposed Isthmian program.

The Institution will utilize its existing shore facilities in the tropics to maintain adequate local research support. As necessary, it will assist in the operation of ships.

Another Smithsonian activity aimed at resolving National oceanography problems is concerned with the processing of marine specimens. We have established in Washington, D.C., the Smithsonian Oceanographic Sorting Center, and this

Center has proven so successful that a regional extension of the activity has been established in Tunisia.

During the last decade, oceanographic expeditions have collected vast quantities of marine biological and geological specimens. From these collections, scientists derive information on the classification, ecology, and population dynamics of marine organisms and the history of the ocean. Specific evaluations first require the separation of these heterogeneous samples into discrete workable units—a time-consuming and routine process with caused the scientist frustrating delays between collection and scientific analysis. A means was sought of promoting the efficiency of this necessary task of intermediate processing. From this recognized need grew the concept of a sorting center.

The Smithsonian Oceanographic Sorting Center (SOSC) was established in December 1962 to act as a service organization to the scientific community by receiving, sorting, recording, and distributing marine biological and geological specimens. Although SOSC was originally developed primarily to process the collections of the International Indian Ocean Expedition, the idea of a centralized processing unit was so enthusiastically received that SOSC's scope was broadened immediately. The Center was flooded with marine collections from expeditions around the world and with requests for processed specimens from scientists across the country and in foreign institutions.

The service of SOSC begin at the time of collection. Research ships are given records forms to insure that specific categories of data are provided which are essential to the scientist in his evaluation of the sample. Preferred collection and preservation techniques are demonstrated by SOSC personnel while aboard ship. Shipping containers and other supplies are provided for shipboard use after tests at SOSC and in the field to determine the most effective and efficient methods of handling the specimens. At SOSC a file or reference number is given to all preserved biological materials and sediments received either for sorting or for transshipment. Once registered, material received only for transshipment is tested for preservation, repacked, and forwarded to the designated recipient. Specimen shipments destined for SOSC processing are unpacked; preservative is adjusted to proper pH level or replaced if necessary; specimens are packaged in suitable containers; and the lots are designated shelf space for temporary storage.

The samples are sorted to arbitrary groups depending upon the needs of specialists and the technicians' capabilities. For example, an Algal Section sorts to genus for marine benthic algae, dispatches phytoplankton by aliquots, and sorts the remaining plants to the highest category, i.e., lichens, mosses, and fungi. Plankton is sorted to about 60 categories; benthic invertebrates to 90 groups; and midwater-trawl invertebrates to 45 groups. Fishes are sorted generally to species level, with the exception of the larval fishes in which an attempt is made to sort to family. Only preliminary efforts have been made in sorting marine sediments. Sorted specimens are counted, placed in fresh preservative in containers along with permanent labels detailing collection data, and then filed. Sorted groups are distributed according to the commitments made by expedition leaders and principal investigators and/or to the recommendations of committees advisory to SOSC. These committees are composed of prominent U.S. systematists. Usually, for convenience, a specialist from the U.S. National Museum serves as committee chairman. Before shipment, all specimens are rechecked by an experienced Museum Specialist for proper identifications. Specimens are carefully invoiced, with copies of all associated data being supplied for the scientists's reference. Specimen containers are sealed to prevent leakage; fish specimens are either placed in jars or carefully wrapped in muslin, tagged separately, and encased in polyethylene tubing. After the specimens have left SOSC, records-keeping duties continue. Information is kept on progress of the specialist's research and publications and on the disposition of specimens including disposition of types at institutions authorized by the advisory committees.

Since January 1963, 34,545 samples of marine organisms and sediments have been received. From 26,717 of these samples, 15,256,659 specimens plus 277,895 cc. of an estimated 2,000,000 shell fragments have been sorted to date. During FY 1967, 6,885,151 specimens were sorted. Two hundred seventy-six (276) shipments were made, including 3,675 unsorted lots and 21,050 sorted lots, the latter containing 989,595 specimens. A total of 1,000 shipments of marine specimens have been sent during the four and one-half years of SOSC existence. These shipments included 7,650 unsorted lots and 41,823 sorted lots, the latter including 5,542,631 whole specimens and 277,895 cc. of shell fragments.

Two hundred fifty-four (254) specialists have been approved by the seven Advisory Committees and/or by principal investigators to receive biological and geological material processed at SOSC. Of these, 139 receive benthic and mid-water-trawl invertebrates; 64 (50 duplicates) receive plankton groups; 80 (6 duplicates) receive fishes; 14 receive algae; and 3, other plant groups; and 10 receive geological specimens. These authorized recipients include specialists from the United States and from 26 foreign countries: Argentina, Australia, Austria, Belgium, Brazil, Canada, Cuba (displaced), Denmark, France, Germany, Ghana, Great Britain, Hong Kong, India, Israel, Italy, Malgache, Netherlands, New Zealand, Nigeria, Norway, Puerto Rico, Singapore, Sweden, U.S.S.R., and West Africa.

Inherent in the type of service provided by SOSC is the requirement for accumulation and dissemination of data. The objectives of SOSC are to improve manpower usage by freeing sorting technicians from records-keeping chores and to provide more accurate, complete, and efficient services to scientists. Improvements have included the use of a card-filing system and/or statistical master lists to maintain a station-by-station report of sorting progress. Sorting sheets have been designed to allow rapid enumeration of data, to call attention to organisms likely to be encountered in samples, and to indicate relationships between taxa as an aid to association of group characteristics. In view of the vast and growing volume of data at SOSC, it has become evident that these objectives can be met only by instituting Automatic Data Processing (ADP) along with improved manual procedures.

With the technical advice and assistance of specialists in systems analysis, an ADP system has been designed and modified to suit SOSC's specific requirements. Upon initiation of this system, sorting data will be readily correlated by machine with Reduced Data Sheets of sampling and environmental information obtained from collectors' field logs. Standard reports will be programmed for rapid location of data on specific parameters—for example, the determination of areas in which given taxa have been present. These reports also will include information on the present location of specimens either at SOSC or at other institutions for identification and study.

SOSC has found it necessary to train its sorters. Initially, training in general sorting techniques and specimen identification is provided by the daily supervision of more experienced technicians and specialists. Training tools available in each section include desk reference textbooks, atlases compiled with specimen descriptions and illustrations, photograph and slide files of infrequently seen specimens, and such devices as the Nikon Comparator available in the Plankton Section which provides a TV-screen-size blow-up of specimens conveniently viewable by a large group simultaneously. More specialized training has been made available by the initiation of a program of twice-weekly lectures on specific recognition and identification of taxa. When interest and initiative are demonstrated, an employee is encouraged to further his formal education as a complement to the daily instruction he receives.

During the past four and a half years a total of 138 persons have been gainfully employed at the Sorting Center. Of these almost 80 have received training as technicians, many of them taken from the Department of Labor unemployed lists. Nearly all of those who are former employees have gone on to better paying permanent positions after a period at the Sorting Center. In the future we hope to employ training personnel, thus engaging in training as a formal part of the operations.

The Mediterranean Marine Sorting Center (MMSC) began operations November 2, 1966, in an office and two laboratories of the Institut National d'Oceanographie et de Peche, in Salammbo, Tunisia. Tunisia was chosen primarily for its location in the central Mediterranean and because of the enthusiasm of the scientists and Government of Tunisia to cooperate with the Smithsonian Institution in this project. The Institut is situated on the Gulf of Tunis, 12 km north of Tunis, at the traditional site of the ancient and important seaport of Carthage.

The first Director of the Mediterranean Center is Mr. David M. Damkaer who is on the regular staff of the Smithsonian Institution, and who normally serves as Supervisor for Plankton at the Smithsonian Oceanographic Sorting Center. A professional scientist will be recruited, from Tunisia whenever possible, to supervise each section. Five technicians from Tunisia are currently employed by MMSC. All of these have had university studies in biology;

some have studied abroad. All speak some English. They have passed several months in training in every aspect of collection-handling. With the arrival at MMSC of large collections, the original technicians will help in the training of new technicians, added as the demands for services increase.

The Center sorts collections of the Institut National d'Oceanographie, which has continuing sampling programs for fishes, benthos, and plankton. Some plankton has been sent to MMSC by the Stazione Zoologica in Naples. Many quantitative benthos and sediment samples have been received from a recent Yugoslavian-Tunisian survey of the Lake of Tunis, a brackish, eutropic lagoon. The Institute for Sea Research at Portoroz, Yugoslavia, provided 174 plankton samples from the northern Adriatic Sea. Three specimen groups (cladocerans, chaetognaths, and fish eggs and larvae) had been committed by the Institute for Sea Research and MMSC was asked to distribute the remaining groups to approved specialists. Mediterranean-Red Sea collections from many sources will be accepted by MMSC for processing and distribution.

Mr. Chairman, in summary, let me note that since the days of Baird, the Smithsonian Institution has conducted research in biological oceanography, ichthyology, and marine geology. We are in this context an important scientific and intellectual resource for the Nation in the development of its national oceanographic program.

I thank you.

Mr. Rogers. Thank you for an excellent presentation. We are very grateful to you.

Mr. Reinecke?

Mr. Reinecke. Thank you, Mr. Chairman. It is a fine presentation.

Dr. Galler. Thank you.

Mr. Reinecke. I am interested in knowing—I believe the Smithsonian has a member on the Marine Council, does it not?

Dr. Galler. Yes, sir, Mr. Congressman; Secretary Ripley is the Smithsonian's representative.

Mr. Reinecke. And there is actual liaison there and coordination?

Dr. Galler. Yes, there is.

Mr. Reinecke. Do you find many of the other agencies of government coming to you for help or coordination in this field?

Dr. Galler. There is a continual exchange, Mr. Reinecke, of information, and to be very specific, indeed yes, we have numerous requests from the Department of Interior, from the Navy and from other R. & D. agencies or R. & D. components of other agencies for identification of materials.

The sorting center is trying to respond to them.

Mr. Reinecke. You also respond to them?

Dr. Galler. Very much.

Mr. Reinecke. One other question.

Regarding the laboratory in Panama, do you anticipate any problems down there because of the pending political problems in the treaty negotiations?

Dr. Galler. No, sir; we do not.

Forgive me if it sounds as if we are being rather paradoxical, but the Smithsonian Institution has a rather enviable position in Panama. We are well liked, respected and considered to be neutral and "apolitical," if you please.

Mr. Reinecke. Thank you very much.

Mr. Rogers. Mr. Edwards?

Mr. Edwards. Thank you, Mr. Chairman.

Doctor, you have given us a good presentation this morning. I gather from what you say that you see the Smithsonian's role in the general oceanographic field as being the source of information for all persons, all of the agencies that are involved in this field, and you put together this information and make it available to all of these agencies?

Dr. Galler. Yes, sir.

Mr. Edwards. Is this what you see as your paramount position in the oceanographic field?

Dr. Galler. I believe it is, Mr. Congressman, by virtue of our responsibilities for maintaining and curating the national collection, and the fact that many, in fact most of our science faculty are collection-oriented. They have joined the Smithsonian faculty because they do wish to work up the collections.

Mr. Edwards. You have been an active participant in the Council. Does the Council have anything to say or do with regard to projects that you will carry out, or do you clear certain projects through the Council? To what extent do you subordinate your own activity to the wishes or desires of the Council?

Dr. Galler. So far, there has not been any question of subordinating our interests to the interests of the Council. Quite to the contrary, the Council has provided the Smithsonian with a window on our national oceanographic problems and aspirations and I think the information that we derive from the Council has been very helpful in orienting our thinking in trying to be more responsive to the national need.

Mr. Edwards. It indicates to you perhaps, from what you see in observing the Council and in communication with the Council members, areas that the Smithsonian feels it can operate in to help the overall picture of determining what is down there?

Dr. Galler. Yes, sir.

Mr. Edwards. Part of the time you were talking I will have to admit I did not understand what you were talking about.

What is a taxonomist?

Dr. Galler. A taxonomist is a person who is engaged in identifying, determining what a particular organism is, is it fish or fowl, is it a particular kind of insect, is it a particular kind of fish, is it a particular kind of plant? Now, there is more to identification than just giving it a Latin name. But once an organism is identified and is essentially compared with similar or specific organisms, then it opens up a vast collection of information that has been gathered over many, many years regarding the biology, the ecology, the behavior of the organism. So, in a sense, identifying an organsm is kind of like the reference card that tells you where to go in the library and discover what we know about this particular species and what we need to discover.

It also provides scientists with an opportunity to assess the particular position of an organism in evolutionary biology, is it a higher form, a lower form, a recent form, an ancient form?

And while this perhaps is not immediately applicable to the solution of problems, it is part of the base line of fundamental information that contributes to a better understanding of the biology and the behavior and the eventual exploitation of some of these organisms.

Mr. Edwards. Did I understand you to say that you are not getting enough taxonomists; there are not enough being trained?

Dr. Galler. That is correct, sir.

Mr. Edwards. Is this a serious problem?

Dr. GALLER. I consider it to be one of the underlying problems confronting marine biologists in the United States today.

Mr. EDWARDS. What do you see as the answer to encouraging young men and women to go into this field or accept this type of training?

Dr. GALLER. Several things, Mr. Edwards.

One, improved job opportunities. It is well to note as the need for taxonomic information increases, the opportunity for placing persons with taxonomic training has been decreasing. Prior to World War II some of the most important marine biological collections resided not in museums but in universities, but with the advent of molecular biology and some of the more exciting modern fields of endeavor, the universities readjusted their thinking and their training and teaching programs and, instead of expanding their collections and expanding their training of taxonomists, they retrenched and the collections were shipped to the Smithsonian or a few of the other major museums throughout the country, the departments of biological sciences shifted their emphasis so that the classic taxonomist was no longer considered to be important. Rather, they were trying to get molecular biologists, biochemists, physiologists, et cetera. So, I believe improved job opportunities is one.

Secondly, I do believe that within taxonomy itself there is a revitalization that is badly needed. Taxonomy until very recently has been largely a study of the outside morphology of the animal, the number of bumps, the number of appendages, et cetera. We find now this kind of taxonomy does not in itself suffice to give us all of the information we need. We need to make use of the tools of modern biochemistry, of modern biology. We need to know more about the animal in his living state, not just in a jar on a shelf.

So I think that the field of taxonomy itself is undergoing a change which will make it more exciting and more enticing for bright youngsters.

Mr. EDWARDS. Do you feel it is essential to research that will be necessary in the field of oceanography to entice more young people into this field for them to do an adequate job?

Dr. GALLER. Yes, sir; an imperative need.

Mr. EDWARDS. In a lighter vein, how is the raising of the *Tecumseh* coming along? Does that fall in the field of oceanography?

Dr. GALLER. I am not sure if it is part of oceanography, but I am very please to say I have a report from Col. John H. Magruder, it is coming along very nicely and the problem now is to determinate whether a coffer dam is going to be built around the *Tecumseh* or some other means is going to be used for hauling it up.

It is not only a matter of mechanically bringing it up, again it has to be done in a very scholarly way so our archeologists and historians can see just how everything was at the time of the occurrence.

Mr. EDWARDS. And you are going to leave it in Mobile, are you not?

Dr. GALLER. Sir, I have no comment on that.

Mr. EDWARDS. Thank you.

Mr. ROGERS. What plan is being made for scholarships to encourage young people to enter these fields where the supply is short?

Dr. GALLER. I think, Mr. Chairman, that the National Science Foundation, or at least parts of the National Science Foundation are aware of the need to encourage the training of taxonomists.

I really am not in a position to tell you precisely what they are doing, but I have talked with a number of my colleagues over there from time to time and within their limited resources I do believe they are trying to encourage the training of taxonomists.

Mr. ROGERS. I would think with the money they have, they could certainly encourage some.

Dr. GALLER. I would think so.

Mr. ROGERS. Perhaps through this sea-grant college program.

Dr. GALLER. Yes, sir.

Mr. ROGERS. Any suggestions you have to direct to that problem this committee would like to have.

Dr. GALLER. I can offer one suggestion, Mr. Chairman, and this is not specifically addressed to the National Science Foundation, but at present at least the Smithsonian Institution and a few other museums throughout the country represent our major resource in taxonomic research, and I believe that if additional scholarship or fellowship funds could be made available to such institutions, it would be possible to invite and encourage young people to come and work with our faculty.

Mr. ROGERS. I think this ought to be developed.

Let me ask you about a statement you made about rocks dredged from the mid-Atlantic ridge.

It is my feeling we should attack the study of the mid-Atlantic as we did in hitting the moon. Until we have some goal to develop the technology to accomplish this, I think we will be floundering.

What have you found from the little amount of work that has actually been done in the mid-Atlantic ridge? Are there any indications of minerals there? Have you gone to that extent?

Dr. GALLER. I will have to rely on Dr. Aron.

Mr. ROGERS. You might want to submit this for the record.

Dr. GALLER. We will be happy to.

Mr. ROGERS. I think that would be helpful.

(The information follows:)

STUDIES OF ROCKS FROM THE DEEP SEA

The objectives of these studies are to find out what kinds of rocks make up the mid-ocean sea floor, how they form, and what they imply about Earth history. To date, three regions have been examined, all on or near the mid-Atlantic Ridge: 22° N. latitude; the Romanche Trench; and St. Peter and St. Paul Rocks and vicinity. The preliminary results of these studies have been published and are attached. The large number of co-authors on these papers shows the widespread co-operation between Smithsonian scientists and scientists at private U.S. oceanographic institutions.

Contrary to rocks from the continents, we know very little about even the gross distribution and kinds of rocks which make up the sea floor. Marine petrology thus will continue to furnish numerous discoveries in the future.

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ST. PETER AND ST. PAUL ROCKS: A HIGH-TEMPERATURE, MANTLE-DERIVED INTRUSION

Abstract. *St. Paul's Rocks, often postulated to be an exposure of the suboceanic mantle, consists of a wider variety of rocks than previously recognized. These perhaps crystallized at different mantle levels, and were subsequently incorporated and mylonitized in a hot but solid intrusion*

St. Peter and St. Paul Rocks (St. Paul's Rocks) are a tiny group of barren islets 80 km north of the equator and close to the axis of the mid-Atlantic Ridge

(*1*). Charles Darwin (*2*) noted that unlike all other islands which rise from oceanic ridges or from the abyssal plains, St. Paul's Rocks are not volcanic, but rather consist of highly sheared (mylonitized) plutonic rocks. This has been repeatedly confirmed (*1*), and much additional interest has been stimulated by the suggestion that these islet are in fact an exposure of the suboceanic mantle (*3*, *4*).

During cruise 20 of R.V. *Atlantis II* of the Woods Hole Oceanographic Institution, considerable work was done about St. Paul's Rocks, including the most detailed geological survey to date (*5*). During this survey and from two large dredge hauls taken from submarine talus slopes immediately south (dredge 7) or southeast (dredge 18) of the islets during cruise 35 of R.V. *Chain*, we collected mylonite samples of previously unrecorded compositional and mineralogic heterogeneity (*6*).

Descriptions follow based on the petrography of about 200 samples, on electron-beam microprobe analyses of mineral grains in many of these, and on the complete wet-chemical analysis of four samples. Table 1 summarizes the latter and gives an estimate of the average composition of the mylonites, based on the observed relative abundances of mylonites of various types, both in near-shore dredge hauls and exposed on the islets. Table 2 describes the mineralogy and locality of each sample in Table 1.

We have found it useful to classify the mylonites in two main mineralogic types: spinel peridotite mylonites (after Tilley, *3*, 7),and brown hornblende mylonites, characterized by abundant brown, alkali-rich hornblende. There is considerable variation among samples within each class. In addition, a third mineralogically distinct mylonite was found rarely on Southeast Islet; this type consists mainly of colorless to light-green clinopyroxene, plagioclase, and scapolite, with subordinate brown hornblende. We suspect that additional petrographic work will reveal other distinct rock types, but only as minority representatives.

Spinel peridotite mylonites, as described by Tilley (*3*, 7) and others (*4*, *8*) are the most abundant rocks on all the islands, and in near-shore dredge samples. Banding due to local concentration of amphibole is common on both Southwest and Southeast islets; amphibole may compose more than 50 percent of some of these bands. Enstatite and chromian spinel are always present. Diopside is commonly present when amphibole is scarce. Serpentine is restricted to joint surfaces and composes less than 10 percent by volume of most of these mylonites.

The second most abundant rock type, previously undescribed from the islets, we have found to be brown hornblende mylonites, characterized by abundant brown alkali-rich hornblende and a large and complex suite of associated minerals. These mylonites are minor constituents of both dredge hauls but occur *in situ* only on Southeast Islet; on this, the second largest islet, we estimate 20 to 30 percent of the surface consists of brown hornblende mylonite, interbanded with spinel peridotite mylonites petrographically identical to those of the other islets. The bands, a few millimeters (Fig. 1) to several meters thick, dip 60°E and strike about N10W, at right angles to the ridge from which the islets rise (*1*).

Particularly important features in unraveling the complex history of the mylonites are large single or multimineral sheared-out grains referred to here as augen (Fig. 2). The augen are thought to be relicts of the premylonitization (primary) assemblages (*3*). Recrystallization and formation of new minerals, particularly of hydrous or chlorine-rich phases, during and after mylonitization have obscured the primary assemblages of many samples. For this reason, the mineral assemblage of a mylonite matrix, although originally derived by granulation of the augen, is not always the same assemblage as that of the augen.

The spinel peridotite mylonites have been divided into two types by Tilley (7) on the basis of the primary assemblages: mylonites with abundant amphibole augen (the "amphibole type") and with abundant diopside and enstatite augen (the "pyroxene type"). We have found that: (i) the "amphibole type" is the most abundant type on all the islets; (ii) the amphibole augen are pargasite; (iii) augen of blue spinel (around $Sp_{80}He_{20}$), plagioclase, and phlogopite are common accessories in the "amphibole type"; (iv) augen of pargasite and diopside may coexist in the same thin section; and (v) the enstatite and diopside of the "pyroxene type" are aluminous.

The primary assemblages of the mylonites may have crystallized in markedly different pressure-temperature environments. The olivine + aluminous enstatite + aluminous diopside + chromian spinel assemblage of the "pyroxene type" corresponds to the assemblages of most olivine nodules of alkali olivine basalts, and is thought to be a stable assemblage at depths between about 30 and about 140 km in the oceanic mantle (*9*). At greater depths, pyrope probably appears (*9*) ; this mineral has not so far been noted in samples from St. Paul's, although searched for in every petrographic examination.

The olivine + pargasite + enstatite + chromian spinel primary assemblage of the "amphibode type" and the paragasite + olivine recrystallized assemblage are stable at much shallower mantle depths, according to Clark and Ringwood (*10*), who argue that such pargasite + olivine ("ampholite") assemblages occur only down to about 30 km in the suboceanic mantle. It appears, then, that the primary assemblages of the "pyroxene type" and "amphibole type" spinel periodotite mylonites equilibrated at, and thus were derived from, different mantle levels. As Ringwood notes (*9*), should P_{H_2O} in the mantle be inhomogeneous, and locally equal the load pressure, this could significantly increase the depth of the stability field of the hydrous assemblage, "amphibole-type" minerals. At sufficiently high partial pressures of H_2O, this assemblage might even have equilibrated at the same temperatures and total pressures as the "pyroxene type"; the two assemblages could, in this case, both have originated from the same depths, considerably greater than 30 km. Viewed in either of these ways, the mineralogy suggests that St. Paul's Rocks represent an intrusion of mantle materials from below 30 km, and one which was intruded too rapidly to permit reequilibration at any shallower depth.

The pargasite augen of the spinel periodotite mylonites are similar to the dominant amphiboles of the banded parts of the spinel periodotite bodies near Lizard, England (*11*), and near Tinaquillo, Venezuela (*12*), which are postulated to be high-temperature, mantle-derived intrusions (*13*). The pargasite augen from St. Paul's Rocks typically have $SiO_2=43$ to 47 percent, $Al_2O_3=10$ to 12 percent, $MgO=17$ to 20 percent, $Fe=2.8$ to 6.0 percent, $CaO=11$ to 13 percent, $Na_2O=2.0$ to 3.3 percent, $K_2O=0.4$ to 0.9 percent, and $TiO_2=0.2$ to 0.5 percent.

The brown hornblende mylonites are characterized by abundant large augen (up to 1 cm across) of brown hornblende. Less abundant and smaller augen of plagioclase, titan-biotite, clinopyroxene, olivine, scapolite, zircon, and allanite (*14*) occur. Although CaO (10 to 12 percent) and Fe (7.0 to 10.4 percent) are in the range of many hornblendes, the brown hornblende augen are uncommonly high in TiO_2 (1.3 to 2.0 percent), Al_2O_3 (15 to 17 percent), Na_2O (2.5 to 3.1 percent), and K_2O (1.0 to 1.8 percent) and low in SiO_2 (37 to 40 percent). Compositionally similar hornblendes have been reported from a garnet-hornblende nodule postulated to be of upper mantle origin (*15*) and in alkalic igneous rocks which crystallized in continental crust (*16*). Optically similar brown hornblende has been reported in the "pseudogabbro" bands of the Tinaquillo periodotite (*12*). Such hornblendes evidently are stable over a wide range of pressure-temperature conditions.

In the St. Paul's intrusion recrystallized assemblages suggestive of high temperatures occur in the matrix of some mylonites and in veinlets. In the spinel periodotite mylonites, such assemblages commonly contain olivine, pargasite, phlogopite, carbonate, and sulfide (mainly pyrite). In the brown hornblende mylonites, a much more complex suite, including some rare minerals, characterizes the recrystallized assemblages; scapolite (*17*), magnetite-ilmenite, analcite, titan-biotite, chloroapatite, chloro-hornblende (*18*) (like dashkesanite), carbonates, and sulfides (including chalcopyrite) have so far been recognized. The stability of olivine in association with hydrous minerals suggests that these assemblages recrystallized in excess of 430°C (*19*) ; this temperature is reached in the crust at about 15 km, based on the commonly postulated average crustal geothermal gradient (30°C/km). This depth is below the M-discontinuity in even the areas of thick oceanic crust beneath the mid-Atlantic Ridge (*20*).

Hess (*21*) has drawn attention to the compositional similarity of the spinel periodotite mylonites to the olivine nodules common in alkali olivine basalts. Because of their low content of basaltic constituents, Tilley (7) and Hess (*21*) rejected previously analyzed spinel peridotite mylonites from St. Paul's Rocks as representative of rocks likely to yield basaltic magma on partial fusion. Tilley (7) in fact suggested that they are perhaps residua of partial fusion. Our two new analyses of low-pargasite mylonites. (7–327 "proxene type," and 7–479 "amphibole type," Table 1) are in accord with these views, and, like the analyses of Tilley (7), show that the "amphibole" and "proxene" types may have essentially identical compositions.

TABLE 1.—BULK ANALYSES OF SPINEL PERIDOTITE AND BROWN HORNBLENDE MYLONITES, ST. PAUL'S ROCKS AND WEIGHTED AVERAGE COMPOSITION OF MYLONITES (90 PERCENT AVERAGE OF 7–327 AND 7–479, 5 PERCENT 18–900, AND 5 PERCENT SE 13, RECALCULATED TO 100 PERCENT).

Component	Spinel peridotite mylonites			Brown hornblende mylonite SE–13	Weighted average mylonite
	7–327	7–479	18–900		
SiO_2	44.35	43.80	42.22	36.64	43.55
Al_2O_3	3.41	2.40	4.42	17.20	3.69
TiO_2	0.08	0.07	0.30	3.99	0.28
Fe_2O_3	1.19	1.41	2.86	2.78	1.45
FeO	7.07	6.22	4.45	8.88	6.64
MgO	38.88	42.13	34.61	6.48	38.45
CaO	2.77	1.13	3.92	[1] 13.30	2.61
Na_2O	0.17	0.14	0.43	3.85	0.33
K_2O	.05	.07	.11	0.80	.10
H_2O+	1.16	1.54	5.73	1.88	1.59
H_2O-	0.13	0.10	0.19	0.12	0.12
MnO	.15	.14	.13	.13	.14
P_2O_5	$<.05$	$<.05$	.05	2.64	.13
Cr_2O_3	.53	.54	.50	<0.02	.51
NiO	.25	.32	.27	----------	.27
Cl	.09	.05	.20	[2] 1.47	.14
CO_2	----------	----------	----------	0.08	$<.01$
Summation	100.28	100.06	100.39	100.24	100.00
Summation (Cl=0)	100.26	100.05	100.34	99.91	100.00
Density	3.28	3.24	2.99	2.97	----------
(Cl, water soluble)	0.02	0.03	0.03	0.07	----------
(Cl, acid soluble)	----------	----------	----------	.65	----------

[1] Includes 0.67 percent Sr (34).

[2] Contains less than 0.05 percent F.

TABLE 2. MINERALOGY AND LOCALITY OF ANALYZED SAMPLES (*35*)

Sample No. and Mineralogy:

7–327: "*Pyroxene type*" *spinel peridotite mylonite.* Primary assemblage: olivine, enstatite, diopside, chromian spinel. Recrystallized assemblage: olivine, pargasite. Dredge 7, R.V. *Chain* Cruise 35.

7–479: "*Amphibole type*" *spinel peridotite mylonite.* Primary assemblage: olivine, enstatite, pargasite, chromian spinel, blue spinel ($Sp_{80}He_{20}$), and phlogopite. Recrystallized assemblage: olivine, pargasite, phlogopite, calcite, and pyrite. Dredge 7, R.V. *Chain* Cruise 35.

18–900: "*Amphibole type*" *spinel peridotite mylonite,* enriched in pargasite. Primary assemblage: olivine, enstatite, pargasite, chromian spinel. Recrystallized assemblage: olivine and pargasite. Considerable secondary serpentine. Dredge 18, R.V. *Chain* Cruise 35.

SE–13: *Brown hornblende mylonite.* Primary assemblage: brown hornblende, plagioclase, magnetite-ilmenite, seapolite, apatite, allanite. Recrystallized assemblage: seapolite, chloro-hornblende, apatite, titan-biotite, analcite, sphene, natrolite. Near north side of Southeast Islet; from band 3 m thick. *Atlantis II*, Cruise 20.

Table 1 includes a pargasite-rich spinel peridotite mylonite (18–900) which is markedly high in basaltic constituents, such as Na, which tend to be concentrated in pargasite. This analysis is similar to the "1:3 pyrolite" of Green and Ringwood (*22*), a postulated mantle composition composed of 1 part basalt and 3 parts dunite, and thought likely to yield basalt on partial fusion. This pargasite-rich mylonite most closely approaches the postulated average composition of St. Paul's Rocks (Table 1), although we estimate that such pargasite-rich mylonites compose only about 5 percent of the islets as a whole.

The brown hornblende mylonites (SE 13, Table 1), although ultrabasic, are remarkably high in Al_2O_3, TiO_2, CaO, the alkalies, P_2O_5, and Cl (*23*). They contain abundant normative diopside, anorthite, and nepheline, and are thus compositionally similar to the alkali olivine basalts of many oceanic islands, which are on the average high in TiO_2 (*24*) and differ markedly from "oceanic tholeiites," probably the most abundant deep-sea basalts (*25*).

Although not yet determined, it is likely that the U, Th, and rare earth contents of the brown hornblende mylonites are unusually high compared to, for example, "oceanic tholeiites." This is suggested by the presence of accessory allanite (*14*) and zircon, as well as by the fact that igneous rocks compositionally similar to the brown hornblende mylonites are commonly enriched in these elements.

On the continents, igneous rocks compositionally similar to the brown hornblende mylonites (Table 1) occur (i) among the ultrabasic members of alkalic igneous rock provinces (*26*), (ii) in association with carbonatites (*27*), and (iii) as alkalic ultrabasic porphyritic dike rocks (lamprophyres). The high contents of volatiles, (Mg+Fe), (K+Na), and Sr especially suggest kinship to the lamprophyres (*28*). Continental igneous rocks compositionally like the St. Paul's brown hornblende mylonites may contain a few of the following minerals (*29*): brown hornblende, titan-augite, plagioclase, nepheline, melilite, apatite, hauyne, and sodalite. Scapolite, an abundant mineral of these mylonites, characteristically occurs in metamorphic rocks and, except for some pegmatites, does not occur as a primary mineral in igneous rocks (*30*).

We have recognized few clues which suggest that the brown hornblende and spinel peridotites are genetically related by a single process acting on an originally homogeneous body, such as gravity differentiation prior to mylonitization, a suggested origin for the spinel peridotite mylonites (*31*), or metamorphic differentiation during mylonitization. On the contrary, the pervasive mylonitization, the juxtaposition of assemblages which may have equilibrated to markedly different pressure-temperature environments, and the diversity of rock types are more consistent with movement of a relatively hot (but solid) plastic rock mass through the suboceanic mantle, and incorporation and shearing out of a variety of unrelated rock types during ascent. The amount of hydrous and chlorine-rich phases in the recrystallization assemblages suggests that each of these rock types contained, during the intrusion, an abundant interstitial fluid phase.

We have noted above similarities between the mylonites of St. Paul's and such continental high-temperature, peridotite-rich intrusions as those of the Lizard complex (England) and of Tinaquillo, Venezuela. Like the St. Paul's intrusion, these latter also contain diverse mineral assemblages; in their cases, however, some of this diversity is attributed to inclusion of crustal contact rocks (*11*, *12*). The thinness of the suboceanic crust makes such inclusion a less likely explanation for the heterogeneity of St. Paul's. A more attractive hypothesis is that the diverse rock types found here were derived in fact from the suboceanic upper mantle, and thus bear directly on its heterogeneity, mineralogy, and composition.

Previous geochemical studies of samples from St. Paul's Rocks, such as those on rare earth elements (*32*), and strontium isotopes (*33*), evidently were done on the spinel peridotite mylonites. Taken alone, neither the spinel peridotite mylonites nor the brown hornblende mylonites have compositions thought to be appropriate for the average composition of the mantle. The former, as a whole, are much too low and the latter much too high in alkalies and probably in U and Th to be appropriate for parental basalt materials, or to be consistent with oceanic heat flow. The pargasite-enriched mylonite (18–900, Table 1) and the estimated average of the mylonites are both more in accord with suggested average mantle compositions.

Clearly, additional analytical studies are needed to evalute the idea that, as a whole, St. Paul's Rocks material is acceptable as compositionally representative of the mantle. We are continuing our study of this interestsing intrusion, both on the suites of samples from the islets and on the extensive suites of samples obtained by dredging about the intrusion.

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METAMORPHISM IN THE MID-ATLANTIC RIDGE, 22°N LATITUDE

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SUMMARY

Greenstones derived from basalts, tuffs, and dolerites were dredged at two stations on the eastern slope of the median valley of the Mid-Atlantic Ridge at 22°N latitude. The rocks consist mainly of the typical greenschist assemblage albite, actinolite, chlorite, and epidote. The greenstones reflect increasing metamorphic grade and intensity of shearing with the depth at which they were recovered.

Bulk chemical analyses of six greenstones give spilitic compositions characterized by high soda (maximum 5.4%) and low potash (minimum 0.05%) contents. Relics of calcic plagioclase, pseudomorphed olivine phenocrysts, and other textural features indicate derivation from abyssal basalts, which typically have soda around 2.7% and potash around 0.2%. The alkali contents of the greenstones are most likely a result of metasomatism during metamorphism, and do not indicate a primary spilitic magma, or reaction between magma and sea water.

The significance of the greenstones in relation to the tectonics and structure of the Mid-Atlantic Ridge is discussed.

INTRODUCTION

Previous work

Rocks previously dredged from the Mid-Atlantic Ridge indicate a terrain made up of fresh basaltic flows on a basement of serpentinites, partially serpentized ultramafics, and gabbroic intrusions (Table I). Fresh basalts have been dominant in most dredges. These are characteristically tholeiitic (ENGEL and ENGEL, 1964; ENGEL et al., 1965) although some have "alkaline affinities" (MUIR et al., 1964). The contrast between dredged abyssal basalts and the common alkali basalts from oceanic islands

TABLE I

IGNEOUS AND METAMORPHIC ROCKS SO FAR NOTED IN DREDGE SAMPLES FROM THE MID-ATLANTIC RIDGE

	References
Basalts	CORRENS (1930); SHAND (1949); QUON and EHLERS (1963); MUIR et al. (1964); NICHOLLS et al. (1964); ENGEL and ENGEL (1964); present study
Gabbros (includes all medium to coarse-grained basaltic rocks)	CORRENS (1930); SHAND (1949); QUON and EHLERS (1963); MUIR et al. (1964); present study
Serpentinite	SHAND (1949); QUON and EHLERS (1963); NICHOLLS et al. (1964)
Quartz–epidote rock after basalt	QUON and EHLERS (1963)
Greenstones	present study

on the Mid-Atlantic Ridge has been pointed out by several authors (MUIR et al., 1964; ENGEL and ENGEL, 1964; NICHOLLS et al., 1964; ENGEL et al., 1965; and NICHOLLS, 1965).

The widest variety of rocks described from the Mid-Atlantic Ridge is that dredged by the Atlantis I during the summers of 1947 and 1948 (SHAND, 1949; QUON and EHLERS, 1963). Unfortunately, few of these rocks have been adequately described. Of particular interest is the quartz–epidote rock dredged from 49°16′W 30°04′N by the Atlantis I. QUON and EHLERS (1963) point out that it was derived perhaps from a basalt. Although it lacks albite, actinolite, and chlorite, minerals which characterize greenschist facies metabasalts and the 22°N greenstones, the epidote–quartz rock suggests that greenschist facies rocks may be among the remaining undescribed Atlantis I samples.

Greenstones were first reported from the deep-sea floor by MATHEWS et al. (1965) from the Carlsberg Ridge, Indian Ocean. However, detailed data on these are not available to the writers at present, and thus a comparison with those of the present study is not possible.

Present study

Greenschist facies rocks, and unmetamorphosed basaltic rocks were dredged between 22° and 23° N latitude on the Mid-Atlantic Ridge by the R. V. "Chain" of the Woods Hole Oceanographic Institution during October, 1964 (VAN ANDEL et al., 1965). These are the first recorded albite–chlorite–epidote–actinolite rocks from the Mid-Atlantic Ridge and their detailed description is the main subject of this paper. The results of a preliminary study of these rocks have been summarized previously (MELSON et al., 1966).

The greenstones were found with fresh basalts and dolerites in two dredges

TABLE II

DISTRIBUTION OF ROCK TYPES IN DREDGES 2 AND 3

	Number of fragments which weigh more than 5 g	
	dredge 2	*dredge 3*
Fresh basalts	18	3
Dolerites[1]	9	6
Greenstones	106	132

[1] Some of these contain small amounts of deuteric chlorite and, rarely, actinolite, and are more appropriately termed diabases.

from the eastern slope of the median valley. Other dredges in the area revealed unmetamorphosed basalts which are increasingly "weathered" west of the median valley. Table II gives the distribution of rock types in the dredges. The fresh igneous rocks from the 22°N area are presently being studied, but the preliminary results of that study are not included in this paper.

The area of the Mid-Atlantic Ridge from which the dredge samples were obtained was surveyed in detail during cruise 44 of R. V. "Chain" (VAN ANDEL et al., 1965) and cruise 1 of R. V. "Thomas Washington" of the Scripps Institution of Oceanography in 1965. The bathymetric survey was controlled by means of celestial fixes and a set of radar reflector buoys. A generalized bathymetric map is shown in Fig.1a. In this area the ridge possesses a well-developed median valley with a maximum depth of 4,200 m, bordered by two crestal ridges with minimum depths between 1,200 and 2,400 m. The flanks of the valley are generally steep, ranging from 15° to 45°. The dredge hauls are from the northern part of a long, slightly curved, steep slope probably representing a major fault scarp. The slope of the section dredged averages 33° and consists of three straight slope sections separated by short steps. Such three step slopes are common along both sides of the valley in this area.

Analytical methods

The greenstones were analyzed by traditional wet chemical means by E. Jarosewich of the Division of Meteorites. Mineral compositions were determined with an A.R.L. electron microprobe by W. G. Melson. Homogeneous minerals which are similar in composition to those in the greenstones were used as microprobe standards, and no corrections were made for the slight differences in matrices. Determinations of chlorite compositions are based on a chlorite standard analyzed by D. Foster of the U. S. Geological Survey (unpublished, U.S.N.M. 109481). Actinolite compositions are based on an actinolite kindly furnished by Dr. F. R. Boyd Jr., and a hornblende furnished by Dr. Brian Mason. Both were analyzed by H. B. Wiik. Plagioclase compositions were determined using glasses of plagioclase compositions. Optical and X-ray diffraction data are also given for some minerals.

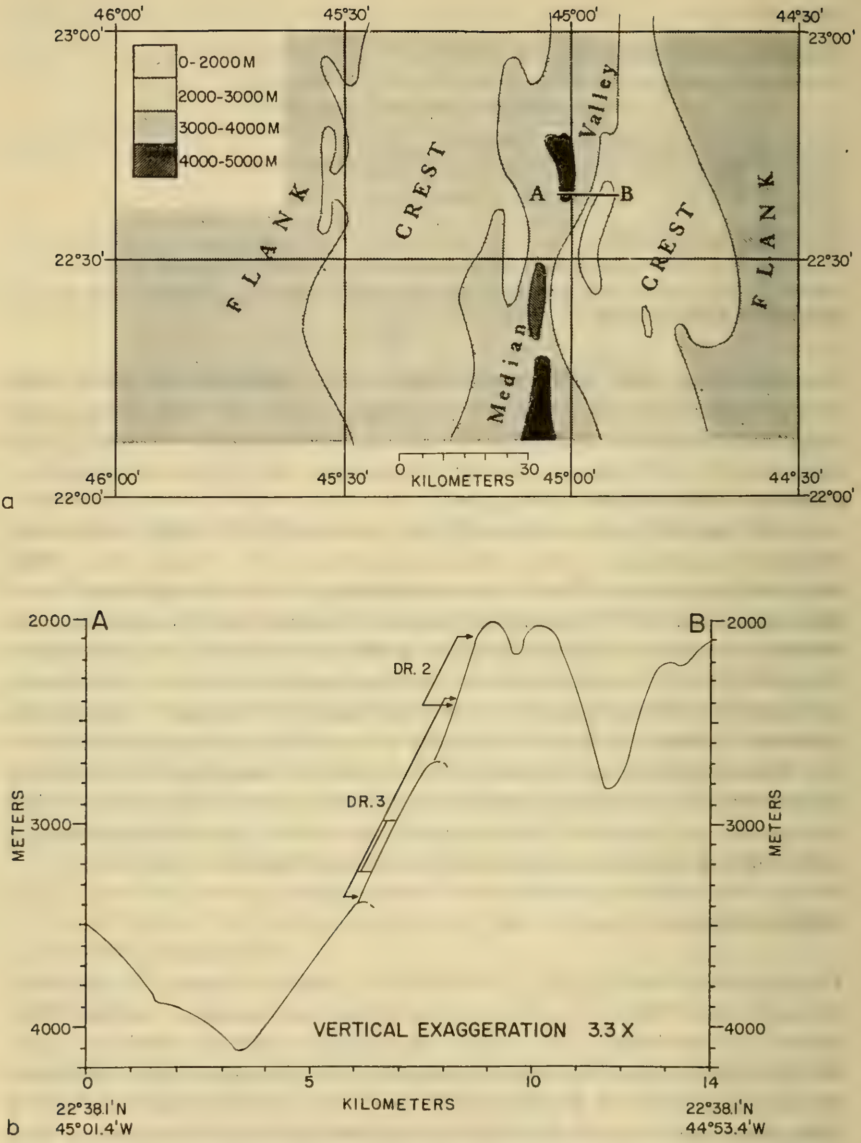
46°00'
45°30'
45°00'
44°30'
23°00'
22°30'
22°00'
0-2000 M
2000-3000 M
3000-4000 M
4000-5000 M
FLANK
CREST
Median
Valley
CREST
FLANK
A
B
0
KILOMETERS
30
a
2000
A
B
2000
DR. 2
DR. 3
3000
METERS
3000
METERS
4000
4000
VERTICAL EXAGGERATION 3.3 X
0
5
10
14
KILOMETERS
22°38.1'N
45°01.4'W
22°38.1'N
44°53.4'W
b

Fig. 1. a. Location of dredged slope in relation to topography of central part of Mid-Atlantic Ridge. Generalized contours in meters corrected for variations in sound velocity in sea water (MATTHEWS, 1943). *A–B* is location of dredged cross-section shown in b.
b. Topographic profile of bottom and east flank of median valley at 22°38′N latitude. Approximate dredge tracks are shown; double line in *DR. 3* track indicates portion from which most or all of the sample probably was recovered.

GREENSTONES

General features

The principal minerals in the greenstones are chlorite, albite, actinolite, epidote, and nontronite. Chlorite and albite occur in the greenstones from both dredges, but the remaining minerals may or may not be present in a given specimen. The source rock of a given greenstone is generally petrographically obvious. Most were derived from basalt flows and many features, such as relicts of calcic plagioclase in otherwise albitized phenocrysts and microlites, preserve the stages in the mineralogic transformation from basalt to greenstone. Dolerites and lapilli tuffs, the latter perhaps being the first recorded tuffs dredged from the Mid-Atlantic Ridge, were the source rocks for some of the greenstones.

Contrast between dredges

The greenstones from the two dredges differ in several ways (Table III). The mineralogic differences are largely in the relative amounts of chlorite, nontronite, epidote, actinolite and albite. Nontronite is extremely rare in dredge 3 greenstones. Similarly, epidote and actinolite, which are abundant in dredge 3 greenstones, are rare in those from dredge 2. The scarcity of epidote and actinolite, and abundance of nontronite in dredge 2 greenstones suggest zeolite facies "affinities", whereas most dredge 3 greenstones clearly belong in the greenschist facies. There are, however, some metadolerites in dredge 3 which consist largely of unalbitized plagioclase and abundant chlorite and nontronite.

The rocks from dredge 2 have a thin manganian coating usually on all sides. This observation and their angularity suggests that they were collected from a slowly accumulating talus slope. The collection from dredge 3 exhibits only very thin and spotty manganian coatings, and the fresh, unweathered aspect of the uncoated faces

TABLE III

CONTRAST BETWEEN DREDGE 2 AND DREDGE 3 GREENSTONES

Dredge 2 (upper slope)	*Dredge 3 (middle slope)*
essentially undeformed	some have incipient schistosity
abundant metatuffs with nontronite	none
zeolites may be present in small amounts but presence could not be confirmed	none noted
abundant quartz veins, and matrix locally replaced by quartz	rare
Epidote rare, chlorite abundant	chlorite rare, epidote abundant

indicates that rocks had been only recently exposed. The preservation, unbroken, of thin platy fragments in the dredge 2 we take to indicate that the fresh surfaces of the dredge 3 fragments are unlikely to have been produced in the dredge.

Zeolites were searched for in dredge 2 greenstones petrographically, and by X-ray diffraction. However, none was noted even though light fraction concentrations were also examined. The lack of zeolites is surprising in view of the otherwise very low metamorphic grade features of the dredge 2 greenstones.

The extent of deformation is roughly proportional to the depth at which the greenstones were dredged. The dredge 3 greenstones are characteristically sheared; some show a schistosity and many are brecciated (Fig.2). On the other hand, dredge 2 greenstones are mainly undeformed and the primary igneous textures are clearly preserved (Fig.3).

There are also differences between the dredges in the types of rocks from which the greenstones were derived. Metabasalts and metadolerites are abundant in both dredges, but dredge 2 greenstones include a number of nontronites and chlorite-rich metatuffs. The metatuffs are undeformed and consist of lapilli of originally glass-rich basalt in a fine-grained ashy matrix. The glass is, however, completely replaced by ripidolitic chlorite.

These features suggest that metamorphic intensity increases with depth in a pile of basalts capped with interbedded basaltic tuffs and flows.

Mineralogy

Several features of the mineralogy help to define more clearly the metamorphic facies of the rocks and are worthy of special comment. Other features of the mineralogy are summarized in Table IV.

Fig.4 gives a plot of the Al, Fe, and Mg contents of actinolite and chlorite in two greenstones recalculated in terms of FeO, MgO and Al_20_3. Thus, all Fe has been assumed as FeO; actinolites and chlorites from previously studied greenstones are also plotted and total Fe in these was recalculated as FeO.

Two features are apparent in Fig.4. First, the actinolites show a wide range of composition in a given rock and it is thus evident from microprobe data that equilibrium was not attained. This is further evident petrographically in, for example, the presence of relic calcic plagioclase. A second feature is the general similarity in the compositions of the actinolites and chlorites from 22°N to the compositions of actinolite and chlorite from previously studied greenstones.

The alumina and soda contents of amphiboles in basic metamorphic rocks have been shown by numerous authors to be sensitive indicators of metamorphic

TABLE IV

MINERALOGY OF GREENSTONES

Mineral	*Occurrence*	*Properties*	*Composition*
Albite	replacement of calcic plagioclase microlites and phenocrysts; and rarely as a vein mineral	$2V_z$ at 85° (low albite). Twinning largely destroyed by albitization	An_1–An_4
Calcic plagioclase	cores of albitized microlites and phenocrysts	—	as high as An_{75}
Chlorite	replacement of glassy matrix, pseudomorphs after olivine crystals; abundant vein mineral, partially replaces plagioclase; fills vesicles; commonly intergrown with actinolite	N_z at 1.62 anomalous blue to reddish brown colors under crossed nicols	ripidolitic in all examined greenstones, typical composition $MgO = 20\%$, $FeO = 19\%$, $Al_2O_3 = 18\%$. $C_0 = 14.2$Å
Actinolite	in fibrous aggregates, abundant replacement of matrix; commonly occurs in quartz veinlets; pseudomorphs clinopyroxene (?) in metadolerites	pleochroic from colorless to light green or brownish green, optics range widely, typically $N_z \wedge Z$ at 21°, $N_z = 1.644$, and $N_x = 1.626$	47–64% tremolite molecule; ranges from 1.8 to 6.9% Al_2O_3 in *3-3* and *3-6*; maximum Al_2O_3 in *3-7* (7.4%). 14 analyses of actinolite in *3-7* give average $Al_2O_3 = 4\%$.
Epidote	Veins and in sheared monominerallic aggregates (epidosites); does not occur as replacement of pre-existing minerals or matrix; commonly occurs in euhedral crystals large compared to chlorite and actinolite	—	weakly zoned, margins may be either higher or lower in Fe_2O_3. Average composition (8 analyses) about 75% clinozoisite molecule
Quartz	In veins, matrix, and rarely as vesicle filling with chlorite (*2-5*). Generally present in small amounts.	—	—
Sphene	Replacement of Fe–Ti oxides; occurs in all specimens; rare relict Fe-Ti oxides are coated by leucoxene	—	—
Pyrite	Small euhedral crystals commonly in or near quartz, chlorite and/or epidote veins	—	—
Spinel	Rare euhedral crystals unaltered; identical in color to spinels in fresh basalts from dredge 2	—	not examined by microprobe
Nontronite	Abundant in metatuffs in dredge 2 where it commonly replaces ripidolitic chlorite. In dredge 3 in veins and rarely replaces epidote	$N_z = 1.56$, $N_x = 1.54$; pleochroic: light yellow or light brownish yellow. $C_0 = 12.6$Å	decomposes under microprobe, no reliable analyses obtained

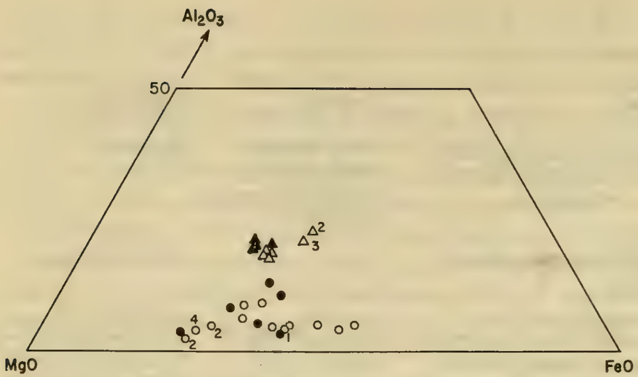

Fig.4. Composition of actinolites (triangles) and chlorites (circles) in terms of Al_2O_3, MgO and FeO. Results from partial analyses done on ARL electron microprobe using mineral standards. All Fe assumed to be as FeO; thus, actual FeO less than indicated. Analyses of actinolite and chlorite from other low grade basic rocks included. In these, total Fe was calculated and recast as FeO. Previously analysed actinolite and chlorite are from: (*1*) Wiseman (1934); (*2*) Tilley (1938); (*3*) Hutton (1938); and (*4*) Seki (1958). Solid circles and triangles indicate 22°N sample *3-6*; open circles and triangles, sample *3-3*. Electron microprobe analytical error probably a maximum of 10% amount present based on intercomparison of mineral standards.

grade; becoming more aluminous on approach to the amphibolite facies, and more sodic on approach to the lower grades of the "blueschist" facies. The low alumina (Fig.4 and Table III) and soda ($< 0.5\%$ Na_2O) of the actinolites thus further indicate the greenschist facies character of the 22°N rocks.

The nontronite gives a principal basal reflection on diffractometer traces at 12.62Å (acetone-duco cement mount) which is quite sharp, indicating a well-crystallized variety. This is in accord with its large crystal size and distinct optical properties in thin-section and in powders (Table IV). The nontronite was found to decompose under the electron microprobe beam even at low voltages, and thus quantitative analyses were not obtained. However, qualitative analyses are in accord with a nontronite composition (abundant Fe and Al).

Stilpnomelane is common in basic rocks of the greenschist facies (Hutton and Turner, 1936). However, no stilpnomelane was noted in 22°N greenstones. A D_{001} of precisely 12.62Å helps distinguish the nontronite from stilpnomelane which typically has D_{001} equal 12.1Å (Deer et al., 1962b). Furthermore, the basal reflection of the nontronite increases to 17Å after glycolation, and the refractive indices of the nontronite (Table IV) are slightly lower than minimum refractive indices of stilpnomelane.

The 22°N mineral assemblages are compatible with those of the quartz–albite–muscovite–chlorite subfacies or the quartz–albite–biotite subfacies of Turner and Verhoogen (1960). However, the low-alumina content of the actinolite and the absence of garnet clearly show that they are of lower grade than the quartz–albite–epidote–almandine subfacies.

Bulk composition

Five greenstones which are representative of some of the main types were selected for analysis. Table V gives modes on the analyzed greenstones, and Table VI, the analyses and norms.

An ACF plot of these analyses allows comparison of the modes with bulk composition (Fig.5). The approximate range in chlorite and actinolite compositions given in the plot are based on microprobe analyses in which all iron again was assumed to be as FeO. Specimens *3-2* and *3-7*, which are essentially free of chlorite, plot on the actinolite–epidote join, as should be the case. However, greenstones *2-5* and

TABLE V

ESTIMATED MODES OF ANALYZED METABASALTS

	Greenstones[1]				
	2-5	*3-2*	*3-3*	*3-6*	*3-7*
Albite[2]	25	30	30	25	20
Actinolite	40	40	35	45	50
Chlorite	25	5	15	20	2
Epidote	1	20	10	2	25
Sphene	4	2	5	3	3
Quartz	5	—	—	—	—
Pyrite	—	—	—	3	—
Pumpellyite	—	—	trace	—	—

[1] Explanation: *2-5* = unsheared metabasalt; *3-2* = brecciated metadolerite. Abundant euhedral crystals in albite veins; earlier generation of epidote in sheared monominerallic aggregates; *3-3* = brecciated metabasalt. Shears in part later than crystallization of epidote: brecciated coarse-grained aggregates of epidote. Relicts of labradorite; *3-6* = brecciated metabasalt; *3-7* = brecciated metabasalt. Abundant albitized plagioclase phenocrysts.

[2] Includes unalbitized calcic plagioclase.

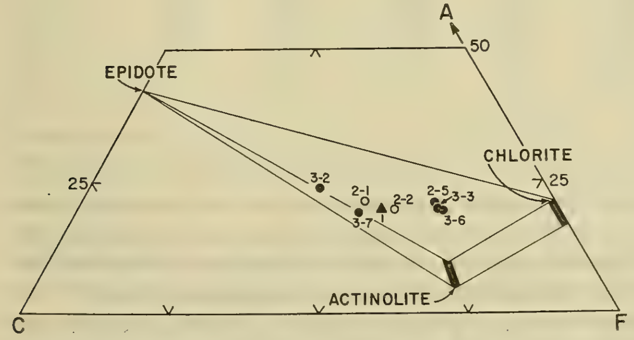

Fig.5. ACF diagram for five 22°N greenstones, two fresh basalts from 22°N, dredge 2 (specimens *2-1* and *2-2*), and the average of 15 Mid-Atlantic Ridge abyssal basalts (*1*).

TABLE VI

ANALYSES AND NORMS OF GREENSTONES, 22°N, MID-ATLANTIC RIDGE[1]

	2-5	*3-2*	*3-3*	*3-6*	*3-7*	*Average*
SiO_2	49.71	50.14	48.18	50.84	51.70	50.11
Al_2O_3	15.32	16.30	15.17	15.25	14.70	15.35
Fe_2O_3	2.05	3.91	2.56	2.89	3.22	2.93
FeO	7.31	3.92	7.18	4.55	4.77	5.55
MgO	8.92	6.35	9.47	9.32	7.13	8.24
CaO	7.32	12.56	7.61	6.44	10.76	8.94
Na_2O	2.93	3.11	3.27	4.48	3.95	3.55
K_2O	0.05	0.11	0.06	0.05	0.08	0.07
MnO	0.16	0.11	0.16	0.16	0.11	0.14
TiO_2	1.51	0.91	1.74	1.38	0.99	1.13
P_2O_5	0.17	0.14	0.15	0.10	0.08	0.13
FeS_2	not sought	not sought	not sought	0.19	not sought	
H_2O^+	3.53	1.86	3.45	3.26	1.93	2.81
H_2O^-	0.93	0.54	0.97	0.74	0.55	0.75
	99.91	99.96	99.97	99.65	99.97	
Density	2.86	2.68	2.74	2.72	2.73	2.74
Norms						
Q	1.06	1.15	—	—	—	
Or	0.30	0.65	0.35	0.30	0.47	
Ab	25.79	26.32	27.67	37.91	33.43	
An	28.50	30.19	26.54	21.36	22.14	
Di	5.49	24.77	8.30	7.92	24.53	
Hy	29.10	6.79	18.29	14.79	8.82	
Ol	—	—	7.06	6.17	1.38	
Mt	2.97	5.67	3.71	4.19	4.67	
Il	2.87	1.73	3.30	2.62	1.88	
Ap	0.37	0.31	0.33	0.22	0.17	
H_2O	4.46	2.40	4.42	4.00	2.48	
An/Ab + An	53.48	53.43	48.96	36.03	39.85	
FeO/Fe_2O_3	3.57	1.00	2.81	1.57	1.48	

[1] Analyst: Eugene Jarosewich.

3-6 do not contain as much modal epidote as would be expected from the ACF plot. This is most likely a result of the presence of unreacted relict calcic plagioclase. The lack of correspondence between the modes of these two specimens and the ACF plot is thus a further reflection of the lack of equilibration during metamorphism.

In order to estimate the extent of contamination by sea water, chlorine was determined turbidimetrically on greenstones *2-5* and *3-6*. These gave 0.013 and 0.027 %, respectively, suggesting very little contamination.

Composition of source rocks

The very narrow range in composition of fresh abyssal tholeiitic basalts so far analyzed has been pointed out by several authors (e.g., ENGEL et al., 1965). Thus, it is likely that the compositions of the source rocks were probably within the range of composition of previously analyzed abyssal basalts. This conclusion is in accord with petrographic features, such as the relict calcic plagioclase microlites and phenocrysts, relict brown spinel, and chloritized olivine phenocrysts (Fig.6).

Comparison with Mid-Atlantic Ridge abyssal basalts

Table VII gives the average composition and standard deviations of published analyses available to the writers of abyssal basalts from the Mid-Atlantic Ridge. These include two analyses of fresh abyssal tholeiitic basalts in dredge 2 from 22°N which will be discussed in detail elsewhere. Also included are the differences between this average and the compositions of the greenstones. Several of these are significantly larger than the standard deviations of the average Mid-Atlantic Ridge abyssal basalt. These are CaO, Fe_2O_3, FeO and MgO, the alkalis, and combined water (H_2O^+).

TABLE VII

COMPOSITION OF GREENSTONES COMPARED TO AVERAGE OF FRESH ABYSSAL BASALTS DREDGED FROM THE MID-ATLANTIC RIDGE

	Average basalt[1]	*Standard deviation*	*Differences between greenstone and average basalt*				
			2-5	*3-2*	*3-3*	*3-6*	*3-7*
SiO_2	49.38	0.62	+ 0.33	+ 0.76	— 1.20	+ 1.[illegible]	+ 2.32
Al_2O_3	16.43	1.17	— 1.11	— 0.13	— 1.26	— 1.18	— 1.73
Fe_2O_3	2.02	0.72	+ 0.03	+ 1.89	+ 0.54	+ 0.87	+ 1.20
FeO	6.98	1.08	+ 0.33	— 3.06	+ 0.20	— 2.43	— 2.21
MgO	8.34	1.16	+ 0.58	— 1.99	+ 1.13	+ 0.98	— 1.21
CaO	11.26	0.51	— 3.94	+ 1.30	— 3.65	— 4.82	— 0.50
Na_2O	2.74	0.18	+ 0.19	+ 0.37	+ 0.53	+ 1.74	+ 1.21
K_2O	0.28	0.17	— 0.23	— 0.17	— 0.22	— 0.23	— 0.20
MnO	0.15	0.03	+ 0.01	— 0.04	+ 0.01	+ 0.01	— 0.04
TiO_2	1.32	0.35	+ 0.19	— 0.41	+ 0.42	+ 0.06	— 0.33
P_2O_5	0.15	0.05	+ 0.02	— 0.01	0.00	— 0.05	— 0.07
H_2O^+	0.63	0.22	+ 2.90	+ 1.23	+ 2.82	+ 2.63	+ 1.30
H_2O^-	0.45	0.30	+ 0.48	+ 0.09	+ 0.52	+ 0.29	+ 0.10

[1] Average composition of 15 fresh basalts dredged from or near the Mid-Atlantic Ridge. Analyses taken from CORRENS (1930, 1 analysis); NICHOLLS (1964, 3 analyses; analyses of rind and interior of same specimen were averaged); MUIR et al. (1964, 5 analyses); ENGEL and ENGEL (1964, 4 analyses); and two analyses of fresh abyssal basalts from the 22°N area (dredge 2).

The compositional variations of the greenstones among themselves and their deviation from the average Mid-Atlantic Ridge abyssal basalt could result from several factors, the main ones being: (*1*) metamorphic differentiation (e.g., CaO and Fe_2O_3 enrichment in epidote-bearing varieties); (*2*) changes in the composition of the rocks as a whole, perhaps due to the passage of hydrothermal solutions, or ion exchange under temperature or other gradients; and (*3*) differences between the compositions of the original basalts. The latter is unlikely in view of the narrow composition spread in abyssal basalts.

Metamorphic differentation, with epidote enrichment on the one hand and chlorite enrichment on the other, can account in part for the inverse relation between the CaO and MgO contents (Fig.7). This may be shown by referring back to Fig.5, and noting that fresh abyssal basalts occupy intermediate positions between greenstones rich in epidote, and those rich in chlorite. Fig.2 shows a clot of epidote crystals (essentially an epidosite) which is typical in the high CaO greenstones.

H_2O^+ is also proportional to the amount of chlorite present. Greenstones with high MgO + FeO and low CaO (*2-5*, *3-2*, and *3-7*, Table VI) have high H_2O^+. Partial replacement of plagioclase phenocrysts and microlites by chlorite is common in such greenstones (Fig.6).

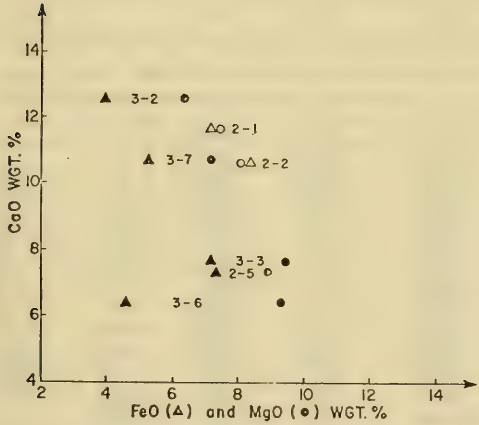

Fig.7. FeO and MgO versus CaO of 22°N greenstones (solid) and of two fresh basalts from dredge 2 (open).

The generally low K_2O content, high Na_2O, and enrichment of *3-6* in sulfur, and depletion of *3-6* in FeO are difficult to explain in terms of local enrichment of one or more principal minerals of the greenstones. In *3-6*, which consists of metabasalt fragments in a fine-grained mylonitized matrix, the Na_2O is typically higher in the matrix (around 5.37) than in the fragments (around 3.68), but both values are higher than typical oceanic tholeiites. Specimen *2-5* is the only one of the five analyzed greenstones which contains an Na_2O content equivalent to and even slightly lower than that of some abyssal basalts (ENGEL and ENGEL, 1964, table I, analysis D2-1 and D2-4).

The Na_2O does not vary systematically with the CaO, and MgO + FeO variations in the analyzed greenstones. This further reflects the distinction between metamorphic differentiation effects, which are important only on a hand specimen level, and changes in the bulk composition of the rocks as a whole.

A small decrease in FeO/Fe_2O_3 compared to fresh abyssal basalts is evident. However, *2-5* has a high ratio compared to most oceanic tholeiites. As with the MgO + FeO to CaO ratio, the ferrous/ferric ratio is about inversely proportional to the amount of epidote present.

The comparison with analyses of fresh basalts suggests that the bulk SiO_2 and Al_2O_3 has not been greatly altered, although Al_2O_3 is lower than that of many abyssal basalts. The relative enrichment in H_2O of the greenstones and the slightly higher SiO_2 content suggest that some slight enrichment of SiO_2 may have occurred. This is in accord with the abundance of quartz-rich veins in some of the greenstones, particularly those from dredge 2. The normative quartz in *2-5* and *3-2* is a further contrast between the greenstones and abyssal basalts. Normative quartz is rare in fresh abyssal basalts.

Introduction of sulfur is also evident in the greenstones (*3-6*, Table VI). Pyrite is common in many of the unanalyzed 22°N greenstones, particularly as euhedral crystals in chloritized olivine phenocrysts (Fig.8).

Trace and minor element data are also of interest in a comparison of the 22°N greenstones with fresh abyssal basalts. Such data are presently being obtained and will be reported separately.

Contrast with continental greenschist facies rocks

Small amounts of the potassian phases, stilpnomelane or biotite, are common in continental greenschist facies rocks of basaltic composition (HUTTON, 1938). The occurrence of biotite rather than stilpnomelane is one of the features which distinguishes the quartz–albite–biotite subfacies from the quartz–albite–muscovite–chlorite subfacies of TURNER and VERHOOGEN (1960). Because of the very low K_2O contents of the 22°N greenstones such potassian phases do not occur, and it is difficult to place the greenstones in an appropriate subfacies.

The low K_2O content of the 22°N greenstones may account for the abundance of nontronite in the dredge 2 greenstones. Celadonite, a potassian iron-rich illite, has been described from continental zeolite facies basic rocks, but was not noted in the

22°N greenstones. Nontronite evidently may occur in lieu of celadonite in the low-grade derivatives of abyssal basalts.

Relation to spilites

Compositionally, some of the 22°N greenstones are similar to certain spilites, particularly to those from Anglesey, Wales (VAUGNAT, 1949). Petrographically, the 22°N greenstones are not spilites in the sense the term is used by DEWEY and FLETT (1911) or BATTEY (1956). The lack of augite, presence of abundant pseudomorphs of chlorite after olivine, and relict calcic plagioclase clearly distinguish them from what these writers have termed spilites.

VALLANCE (1960) has, however, discussed the contradictory uses of the term spilite, and perhaps some petrologists would consider the 22°N greenstones spilites. The important point is that the petrographic features of the 22°N greenstones suggest derivation by post-consolidation metamorphism of oceanic tholeiitic flows and tuffs. There is no evidence of derivation of the 22°N greenstones by reaction of molten magma and sea water, or from a primary spilitic magma. If spilites were readily produced by reaction of molten magma and sea water (RITTMANN, 1958), it is surprising that past dredging in deep water in the Pacific and Atlantic has revealed basalts which are essentially unaltered (e.g., MOORE, 1965).

As previously pointed out, the bulk analyses indicate that the high Na_2O contents of the greenstones are not related to metamorphic differentiation, but to an overall composition change. Sea water derived from associated fragmental rocks is commonly postulated as a source for Na in "spilitic rocks". If specimen *3-6* (Table V) had an original Na_2O content of 2.70% (2.00% Na), the average for abyssal basalts, its present Na content (3.31% Na) would require addition of 1.36 g Na/100 g average abyssal basalt. Thus, all Na in 1.28 g sea water (in which Na is assumed equal 1.06%) would be required per gram average abyssal basalt to give the Na content of *3-6*. The large quantity of sea water required makes it unlikely that the albitization occurred as a result of reaction with only static interstitial sea water. Only a system in which access to additional sea water, or in which brines were included in associated sediments, would give sufficient Na. Alternatively, "juvenile" hydrothermal solutions may have played an important role.

Derivation by regional metamorphism

Fresh basalts and dolerites which are similar to those from which the greenstones were derived occur in the dredges which recovered the greenstones. It is thus arguable that the greenstones were produced in a more localized environment; perhaps the dredges crossed a hydrothermal aureole around a volcanic vent. Hydrothermal aureoles at Mull, Scotland, and Thingmuli Volcano, Iceland, are perhaps analagous to the possible 22°N aureole. However, greenstone fragments in sediments ca. 160 km southwest of the dredge sites, and the common schistosity in the dredge 3 greenstones suggest derivation by regional metamorphism accompanied by considerable tectonism[1]. The normal vertical sequence of metamorphic grades is consistent with this view. On the other hand, minerals typical of basic greenschist facies rocks are common in other than regional metamorphic environments. Thus, based on mineralogy alone, it is difficult to establish the origin of the 22°N greenstones. Epidote is a common mineral in hydrothermally altered basalts, and is abundant in the hydrothermal aureole of Thingmuli Volcano, Iceland (CARMICHAEL, 1964). There, however, it occurs with abundant zeolites.

Chlorite is common as a late-magmatic or deuteric mineral in many igneous rocks, and is a characteristic alteration product of olivine and pyroxene in the higher level of flows on Mull (FAWCETT, 1965). The common uralitic amphibole produced by late magmatic reaction between residual liquids and augite in gabbros and dolerites, even where implaced at shallow depth, is typically thought to be actinolite (DEER et al., 1963). Albite similarly may form in veins, amygdules or as replacement of more calcic plagioclase, in many localized environments.

Bearing of the greenstones on the tectonics of the Mid-Atlantic Ridge

Most of the 22°N greenstones were derived from basalt flows. Thus, some burial of the rocks under subsequent flows, tuffs, or sediments was required previous to their present exposure on the sea floor. An important question in interpreting the tectonics of the ridge is the amount of erosion or movement along faults which occurred to bring about this exposure. Because of the slow rates of submarine weathering and erosion, exposure due to faulting was probably dominant.

Exposure along fault scarps is consistent with most interpretations of the ridge, particularly for rocks exposed along the median valley, which is commonly thought to be a rift valley.

The amount of overburden during metamorphism can be roughly estimated from postulated pressures and temperatures of greenschist facies metamorphism. However, the pressures and temperatures of low grade metamorphism are particularly difficult to infer. Difficulty in attaining equilibrium or even nucleation, particularly of epidote, has been bothersome in experimental studies. TURNER and VERHOOGEN (1960) point out that "...estimates of temperatures and pressures of low grade regional metamorphism are little better than a guess". They, nonetheless, on the basis of scant experimental data, and on field evidence, suggest temperatures between 300 and 500°C, and water pressures between 3,000 and 8,000 bar. These numbers are probably the best available.

FYFE et al. (1958) point out that experimentally calcic plagioclase reacts readily to zeolites below 300°C at even low water pressures, and that this temperature is not greatly increased by increasing water pressure. This and the extremely slow rate of reactions below 300°C, are some of the more important data used in placing the lower temperature limit on greenschist facies metamorphism.

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[1] A recent new series of dredges in the 22°N area has recovered more greenstones, and abundant mylonitized dolerites, extending the probable greenstone outcrop to more than 40 km in a north–south direction.

Even in 10,000 m of sea water (equivalent to about 1 kbar), the minimum estimate of 3 kbar (TURNER and VERHOOGEN, 1960) for greenschist-facies pressures would not be obtained. Thus, if this minimum pressure estimate is correct, some burial beneath the sea floor is required. If the metamorphism took place beneath a 5,000 m deep sea floor, an additional 9.1 km of basalt at a density of 2.8 g/ml would be required to give a water pressure of 3 kbar assuming water pressure equals lithostatic pressure.

An alternative approach to obtaining a rough estimate of lithostatic pressure may be based on the minimum temperature of the greenschist facies (300°C, TURNER and VERHOOGEN, 1960). By assuming a steady state temperature gradient, a rock conductivity of 0.004 cal./sec. deg, and using various heat-flow measurements in the Mid-Atlantic Ridge, estimates of the depth to the 300°C isotherm may be obtained (Table VIII). These depths for the high heat-flow value and the average heat-flow value are less than that from the minimum lithostatic pressure estimate. The temperature gradient is inversely proportional to the rock conductivity in a steady-state gradient, thus considerable error in the depth estimate may result from the uncertainty in the assumed conductivity. However, based on the above assumptions, a minimum depth of ca. 2 km of basalt would be required in even the areas of high heat flow, such as those noted by BULLARD and DAY (1961). BARTH (1962) suggests that greenschist facies temperatures may be as low as 100°C. Thus, considerably less cover may have been required than indicated by the temperature estimates of TURNER and VERHOOGEN (1960). On the other hand, WINKLER (1965) estimates higher minimum greenschist temperatures; 400°C at a pressure of 1 kbar.

TABLE VIII

DEPTH AT WHICH 300°C ISOTHERM WOULD BE REACHED BASED ON RECENT HEAT-FLOW MEASUREMENTS, FROM THE MID-ATLANTIC RIDGE, AND ASSUMING STEADY STATE TEMPERATURE GRADIENT AND ROCK CONDUCTIVITY OF 0.004 cal./sec degree

	Heat-flow measurements[1]		
	1	*2*	*3*
Heat flow ($\times$ 10^{-6} cal./cm^2 sec)	6.5	3 (±2)	0.3
Location	47°N	—	20°N
Thermal gradient (°C/km)	160	75	7.5
Depth to 300° (km)	1.8	4	40
Solid pressure[2] (kbar)	0.9	1.5	10.4

[1] Explanation: *1* = uncommonly high heat flow (BULLARD and DAY, 1961); *2* = average of 32 measurements within 100 km of ridge (LEE and UYEDA, 1965); *3* = uncommonly low value (LEE and UYEDA, 1965).

[2] Includes pressure increment due to an assumed 5,000 m of sea water (ca. 500 bars); rock density assumed to be 2.8 g/cm^3, a value typical for abyssal basalts.

In summary, considerable uncertainty exists in placing minimum depths of burial of greenschist facies rocks. However, a minimum value of 2 km beneath an ocean floor at 5 km seems reasonable. The maximum water pressure at such a depth is considerably below some estimates for greenschist facies metamorphism. However, these water pressure estimates are based on very little experimental data and are most likely subject to considerably more uncertainty than the minimum temperature estimates.

Minimum vertical displacement along faults should be on the order of a few kilometers to expose greenschist facies rocks. Such movements are not unreasonable in view of the relative relief of the ridge crests above the median valley in the 22°N latitude area (VAN ANDEL et al., 1965). However, the greenstones may well have been metamorphosed at considerably greater depths, particularly if the water pressure estimates for greenschist facies metamorphism are correct. In this event, simple rift normal faulting may not have been sufficient to give exposure. More complex tectonic movements would have to be invoked, or, alternatively, the possibility of considerable submarine erosion would have to be considered.

The structure of the Mid-Atlantic Ridge is thought by some to reflect tension and collapse occurring above a rising convection current which is constantly adding new crust to the floor of the rift valley. If greenschist facies or higher grade metamorphic rocks are found to be abundant in the ridge as a whole, periods of a halt in this forceful upward movement of material are required. Alternatively, rapid burial may occur. More extensive rock dredging programs are required to clarify the importance of metamorphism in the Mid-Atlantic Ridge as a whole.

Bearing on the M-discontinuity and oceanic crust

ENGEL et al. (1965) suggested that the Mohorovicic discontinuity under oceanic crust may mark the transition of tholeiitic basalts to a "schisted" metamorphic equivalent. They postulate temperatures between 100 and 200°C and pressures of between 1 and 2 kbar at the Moho and suggest that the metamorphic grade should not exceed greenschist or" blueschist" facies. As they point out, transition of basalt to greenschist is not in accord with the geophysical evidence about rocks below the M-discontinuity; the 22°N greenstones, are, in fact, not as dense as most abyssal basalts (average density 2.74 for analyzed greenstones, Table VI, versus 2.80 for fresh abyssal basalts from 22°N). It is thus unlikely that greenschist facies metabasalts occur at or below the Moho.

On the other hand, greenschist and perhaps zeolite facies rocks may be common in oceanic crust, particularly beneath the Mid-Atlantic Ridge. Seismic velocities of the Mid-Atlantic Ridge crustal rocks range considerably even in single profiles (EWING and EWING, 1959) and do not exclude the possibility that greenschists are abundant. Rift faulting of the thick volcanic pile which evidently composes the ridge in places would give ready access to water, either form descending heated sea water, or from hydrothermal solutions derived from the mantle.

A more detailed survey of the greenstone area in 1965 on R. V. "Thomas Washington" indicates that it consists of a lozenge shaped block, 40 km long by 10 km wide in an east–west direction. This block is bounded on all sides by steep slopes of 2–45°, which are probably fault scarps, and rises 500 m or more above the ridge crest elsewhere in this area. It is tempting to stress the analogy of this block with the probable fault block of which St. Pauls Rock is a part in the equatorial Atlantic, where uplift of mantle rocks has been postulated. Perhaps the 22°N greenstones represent a section of the lower oceanic crust. This would imply formation of the oceanic crust by accumulation of sea floor basaltic rocks. Seismic velocity data on the 22°N area would be useful in testing this latter hypothesis, for high velocity rocks should occur at shallow depths.

Ultramafic rocks were not recovered in dredges in the 22°N area and are evidently not abundant there[1]. If the oceanic crust is largely serpentinite, as suggested by Hess (1962), the serpentinite must occur under a considerable thickness of basalts in the 22°N area.

CONCLUSIONS

(*1*) Greenstones composed of epidote, chlorite, actinolite, and albite were first noted from the Mid-Atlantic Ridge in dredges taken at 22°N. Here, they occur at depths between 2,000 and 3,500 m, in a steep eastern slope of the median valley.

(*2*) Fresh dolerites and abyssal basalts occurred as minor constituents of the dredges which recovered the greenstones.

(*3*) The greenstones from the middle slope have typical greenschist facies mineralogy. Higher on the slope, the greenstones are less deformed and the presence of nontronite and common absence of actinolite and epidote suggest even lower metamorphic grade.

(*4*) The greenstones were derived mainly from basalt flows, although many were derived from dolerites and basaltic tuffs.

(*5*) The greenstones are characterized by a range of actinolite compositions in the same specimen, showing that equilibrium was not attained.

(*6*) The 22°N greenstones are most likely a product of regional metamorphism rather than of localized hydrothermal alteration, or of "autometamorphism".

(*7*) The greenstones have spilitic (high soda) compositions, but these are due to post-consolidation metasomatism. Petrographic evidence, such as relicts of calcic plagioclase, indicate derivation from abyssal basalts ("oceanic tholeiites").

(*8*) The low K_2O content gives rise to mineralogic peculiarities in the 22°N greenstones when compared to continental greenstones. This is evident in the lack of such phases as stilpnomelane; and in the occurrence of abundant nontronite rather than celadonite.

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[1] Subsequent dredges in the area did not recover ultramafic rocks although there were eight successful dredge hauls, and about 1000 lb. of rock were recovered.

(*9*) Much of the compositional difference between the greenstones is a result of epidote enrichment on the one hand and of chlorite enrichment on the other.

(*10*) Based on heat flow measurements from the Mid-Atlantic Ridge, minimum depth of burial to obtain minimum postulated greenschist temperatures is around 2 km.

(*11*) Greenschist facies metabasalts may be common in oceanic crustal rocks as a whole, particularly in the mid-ocean ridges.

(*12*) The greenstones may occur in an uplifted block of the lower oceanic crust.

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Greenstones from the Central Valley of the Mid-Atlantic Ridge

In a preliminary report[1] of a recent study of the morphology of the Mid-Atlantic Ridge about 22° N. latitude, attention was directed to the dredging of a suite of greenstones from the western face of the central valley. Although similar rocks have been recently reported from the Carlsberg Ridge[2] in the Indian Ocean, rocks of this type have not been previously recorded from the Mid-Atlantic Ridge. Preliminary petrographic examination and chemical analysis of the Mid-Atlantic Ridge greenstones justify the present interim report.

The collection from the upper slope (Dredge 2, 2,670–2,050 m) consists, as noted[1], of fragments of greenstone, basalt, and partly metamorphosed basaltic tuff. The fragments exhibit a thin manganiferous coating, usually on all sides. This observation and the angularity of the fragments suggest that they were collected from a slowly accumulating talus slope. The collection from the base of the slope (Dredge 3, 4,000–3,200 m) consists of greenstones, and rare fragments of diabase. The greenstone fragments exhibit only very thin and spotty manganiferous coatings, rarely on more than two faces. The distribution of these coatings, and the fresh uneroded aspect of the uncoated faces, indicate that these rocks had been only recently exposed. The preservation, unbroken, of thin platey fragments in Dredge 2 we take to indicate that the fresh surfaces of the Dredge 3 fragments are unlikely to have been produced by fracturing within the dredge.

The greenstones consist of actinolite, epidote, chlorite and plagioclase in various proportions. The latter is mainly albite although some specimens contain relics of more calcic plagioclase. Dredge 2 contains greenstones which are essentially free of epidote whereas in those in Dredge 3 epidote is abundant. Although searched for specifically, zeolites and pumpellyite have not been noted in the 13 greenstones which have so far been examined in detail.

Most of the greenstones are not deformed. In some of the specimens shear planes occur but they are widely spaced and give no well-defined fabric. Because of this lack of intense penetrative deformation, the pre-metamorphism textures are preserved. These show that some of the greenstone fragments were derived from submarine basaltic flows and others from basaltic tuffs.

One of the greenstones analysed has unusually high sodium content (Table 1, No. 1). This specimen is texturally characterized by albite veins, dispersed pyrite and rare relict labradorite. These features suggest that the 'spilitic' composition is a result of hydrothermal albitization during metamorphism. Except with regard to their water content, many of the greenstones (for example,

This is Contribution Number 1697 from the Woods Hole Oceanographic Institution and a contribution of Scripps Institution of Oceanography.

Table 1, No. 2) were evidently derived isochemically from basalts.

The greenstones are associated with basalts in Dredge 2 and with rare fragments of diabase in Dredge 3. Table 1 (No. 3) gives an analysis of a fresh basalt from Dredge 2. This basalt consists of microlites of plagioclase and olivine in a glassy matrix containing rare phenocrysts of plagioclase and olivine. Detailed petrographic and chemical data on these basalts and diabases will be included in the final report on the greenstones.

The occurrence of greenstones raises several questions about the nature of the Mid-Atlantic Ridge. These rocks are not hornfelses and cannot be interpreted as the result of contact metamorphism. The mineral assemblages are in the greenschist metamorphic facies, which is often taken to indicate temperatures of 300°–500° C and water pressures between 3 and 8 kbar (ref. 3). Even in the deep sea, such pressures, along with sustained periods of heating, would require that the original basalts and tuffs were buried under a considerable thickness of subsequent flows or sediments. Because there are very few experimental data available on the actual stability ranges of greenschist assemblages, precise estimates of minimum and maximum depths of burial cannot yet be made. Recovery of the rocks by dredging shows no overburden now to be present; its elimination in recent times by other than tectonic processes presents great difficulties. The burial postulated appears to require a halt in, or a temporary reversal of, the upward movement of material underneath a rift zone, as suggested by Hess[4]. The subsequent raising of buried material to the sea floor, and its exposure there, seems to us perfectly consistent with the suggested tectonic patterns.

Matthews *et al.*[2] have attributed origin of chlorite-rich metamorphosed basalts and gabbros recovered from the

Table 1. CHEMICAL ANALYSES* OF TWO GREENSTONES AND A REPRESENTATIVE BASALT

	(1) Greenstone Dredge 3	(2) Greenstone Dredge 2	(3) Fresh basalt Dredge 2
SiO_2	50·84	49·71	49·10
Al_2O_3	15·25	15·32	15·27
Fe_2O_3	2·89	2·05	2·54
FeO	4·55	7·31	8·36
FeS_2†	0·19	not sought	not sought
MnO	0·16	0·16	0·20
MgO	9·32	8·92	8·09
CaO	6·44	7·32	10·61
Na_2O	4·48	2·93	2·86
K_2O	0·05	0·05	0·25
H_2O^+	3·26	3·53	0·56
H_2O^-	0·74	0·93	0·25
TiO_2	1·38	1·51	1·73
P_2O_5	0·10	0·17	0·16
	99·65	99·91	99·98

(1) Epidote—actinolite—chlorite—albite.

(2) Quartz—chlorite—actinolite—albite.

(3) Rare plagioclase (An_{82}) and olivine (Fo_{85}) phenocrysts.

* Content as percentage of air-dry ground sample. Analysis by standard wet methods for silicate rocks. Analyst Eugene Jarosewich.

† Calculated assuming all sulphur in pyrite, the only sulphide visible in polished sections.

Carlsberg Ridge to hydrothermal processes resulting from cross-faulting. Such a suggestion is not admissible as explanation of the fresh greenstone occurrences on the Mid-Atlantic Ridge; no cross-faulting is reflected in the bottom topography within almost 30 min north or south of their location.

If greenstones similar to those from 22° N. prove to be quantitatively important constituents of parts of the Mid-Atlantic Ridge, interpretations of seismic, magnetic and gravity data from the Ridge cannot be based on models which assume the presence only of fresh basaltic rocks, serpentine and unserpentinized ultramafics in a simple layer-cake sequence. The probability that greenstones are of general importance in the structure of the Ridge is increased by our finding of greenstone fragments in the coarse fraction of sediments from the western flank (P.C. 22, South Pond)[1]: in the specimens examined, chlorite is often associated with phillipsite. Careful examination of all undescribed materials from the Mid-Atlantic Ridge is important in assessing the true abundance of greenstones. Because of the fine-grained nature of the rocks from 22° N., only petrographic inspection of thin sections or of grains, combined with X-ray diffractometry, has allowed precise identifications.

Additional petrographic examinations and chemical analyses are now in process, and an extended report of the study will be published elsewhere. We thank Peter L. Sachs and the scientific party and crew of R.V. *Chain* for their part in the dredging, and Eugene Jarosewich for making the chemical analyses. Various aspects of this work were supported by the U.S. Atomic Energy Commission (contract *AT*(30-1)-2174), by the U.S. National Science Foundation (grants *GP*921 and *GP*1599) and by the U.S. Office of Naval Research (contract *Nonr*-2196(00)), at the Woods Hole Oceanographic Institution, and by the U.S. Office of Naval Research under contract *Nonr*-2216(23) with Scripps Institution of Oceanography.

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Alkali Olivine Basalt dredged near St. Paul's Rocks, Mid-Atlantic Ridge

RECENT studies of deep sea basalts have revealed the great predominance of olivine tholeiites over both normative nepheline and normative quartz basalts[1]. An alkali basalt recently dredged between 2,950 and 1,975 m near St. Peter and St. Paul Rocks (St. Paul's Rocks) consequently seemed worthy of prompt description. Although mentioned in an abstract[2], we have not previously published a chemical analysis of this basalt. This alkali basalt flow is of special interest because it is not part of a large submarine volcano, but rather evidently was erupted directly on a floor of spinel peridotite mylonites similar to and contiguous with those described from St. Paul's Rocks, a probable high temperature intrusion derived from the mantle[3].

Extensive dredging was carried out around St. Paul's Rocks during cruise 20 of the R.V. Atlantis II of the Woods Hole Oceanographic Institution in an attempt to delineate the outcrop of the ultrabasic mylonites which are exposed on the islets. Numerous rock types, in addition to the mylonites, were dredged within sight of the islets; although their study is not yet complete, some of the more interesting have been examined in the laboratory, and a detailed report is in preparation.

One of the most remarkable rock types, the subject of this report, is a vesicular basalt containing abundant small olivine nodules and partly "digested" mylonitized spinel peridotite inclusions. The dredge (No. 43) from which this basalt was obtained is located on Fig. 1.

The ultramafic intrusion exposed at St. Paul's Rocks extends beneath the sea along a ridge elongated in an E.N.E. direction. Dredge samples indicate that the submarine exposures of the intrusion are spinel peridotite mylonites and alkaline ultrabasic brown hornblende mylonites, the two major rock types on the islets[3]. A complex series of rocks which includes fresh and metamorphosed basalts, basaltic pyroclastic rocks, basic and ultrabasic plutonic rocks, and carbonate sedimentary rocks outcrop to the north and south of the intrusive mass. Some of the dredges, even those which only covered a short distance of the bottom, yielded a wide variety of rocks, suggesting that the rocks probably dip steeply around the margin on the intrusion. The alkali basalt described here probably occurs unconformably on the

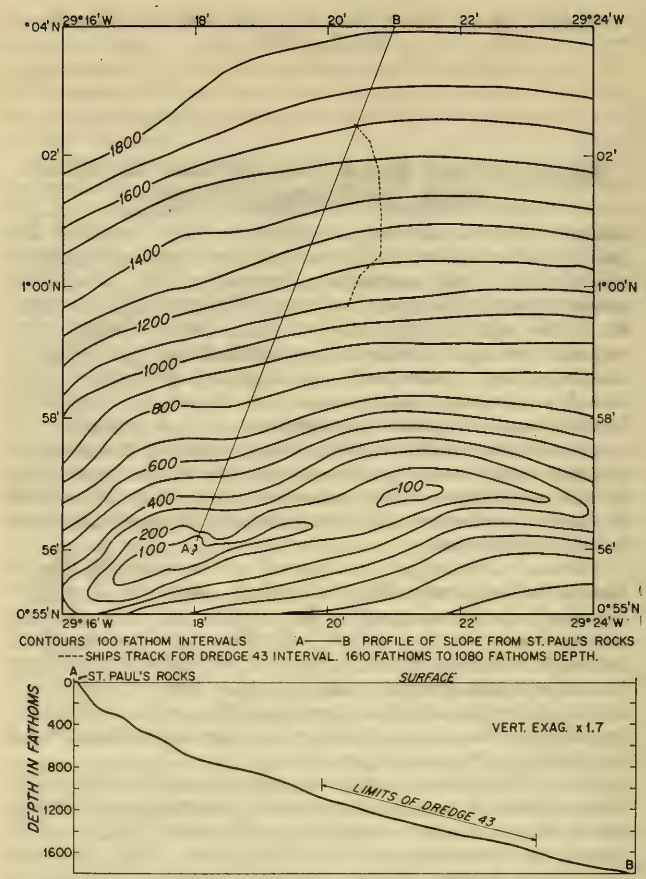
29°16'W
18'
20'
B
22'
29°24'W
°04'N
02'
1°00'N
58'
56'
0°55'N
1800
1600
1400
1200
1000
800
600
400
200
100
100
A
CONTOURS 100 FATHOM INTERVALS
A——B PROFILE OF SLOPE FROM ST. PAUL'S ROCKS
----SHIPS TRACK FOR DREDGE 43 INTERVAL. 1610 FATHOMS TO 1080 FATHOMS DEPTH.
A
ST. PAUL'S ROCKS
SURFACE
DEPTH IN FATHOMS
0
400
800
1200
1600
VERT. EXAG. x 1.7
LIMITS OF DREDGE 43
B

Fig. 1. Bathymetry and location of dredge *A* II–20, 43, St. Paul's Rocks.

intrusion, and is probably much younger than the commonly deformed and altered rocks which rim the intrusion. A large amount of talus derived from the islet was in the dredge on top of the alkali basalt fragments; evidently this talus was the last material to enter the dredge.

Table 1 gives the bulk analysis of a sample from which the nodules were extracted after coarse crushing. The basalt is perfectly fresh in hand specimen and in thin section. To remove any possible salt contamination, the sample was washed in distilled water after fine grinding. The high titania, soda and potash, and the low silica, are particularly significant in the analysis. These features, and the presence of nepheline in the norm, clearly place the basalt in the alkali olivine basalt series. Deep sea basalts may have "alkaline affinities"[4], and may contain abundant normative and modal olivine, but rarely contain normative nepheline in the amount recorded here. The high barium (300 p.p.m.), strontium (500 p.p.m.) and zirconium (200 p.p.m.) further confirm the alkaline nature of this basalt, although the high nickel (270 p.p.m.) and chromium (250 p.p.m.) are anomalous for alkali basalts.

Table 1. COMPOSITION OF ALKALI OLIVINE BASALT*, *A* II–20, 43–49, DREDGED A FEW KILOMETRES NORTH-EAST OF ST. PAUL'S ROCKS

		Norm	
SiO_2	43·15	Or	9·63
Al_2O_3	13·46	Ab	9·67
Fe_2O_3	4·52	An	16·34
FeO	8·22	Ne	10·67
MnO	0·11	Di	22·23
MgO	10·80	Ol	16·76
CaO	9·80	Mt	6·55
Na_2O	3·47	Il	5·13
K_2O	1·63	Ap	1·64
H_2O+	1·21		
H_2O-	0·15		98·61
TiO_2	2·70		
P_2O_5	0·75		
	99·97		

Analyst: E. Jarosewich

* The analysed basalt is extremely fine grained and contains olivine phenocrysts in a matrix of microlites of plagioclase (about An_{60}), titan–augite, olivine and light brown barkevikitic hornblende. Accessories include an iron–titanium oxide, biotite, apatite and possibly haüyne. Small amounts of clear glass and alkali feldspar also occur. Modal nepheline is not present.

The predominance of low potash tholeiitic basalt on the ocean floor and the apparent restriction of alkali basalts to the top of high volcanic edifices has been noted by Engel *et al.*[5]. In the Hawaiian Islands, alkali basalts occur mainly as late, quantitatively minor extrusives. These relationships led some petrologists[6] to postulate, first, that alkali basalts are derived by low pressure differentiation of sub-alkaline olivine basalts of the "oceanic tholeiite" type in near surface magma chambers, and second, that "oceanic tholeiite" magma is the only basaltic magma derived from the mantle. Experimental data indicate that low pressure differentiation of tholeiitic magma should not yield normative nepheline liquids[7], and thus argue against the first view.

The alkali basalt described here also suggests mantle derivation of alkali basalts. The basalt is clearly not part of a thick "oceanic tholeiite" pile (Fig. 1), and thus based on field occurrence alone is an unlikely low pressure differentiate of "oceanic tholeiites". It would appear that "parental" alkali basalt magma originates by some other, more deep-seated phenomena, such as partial fusion of eclogite of tholeiitic basalt composition—a process outlined by Yoder and Tilley[7].

The St. Paul's Rocks situation clearly indicates that it is not always true that oceanic alkaline basalts occur as late eruptives in otherwise tholeiitic sequences. Thus caution should be used in tying the origin of all oceanic alkaline basalts to the situation exemplified, for example, by the Hawaiian Islands.

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Mr. ROGERS. Also, I think you might submit for the record any suggestion you have as to what should be done to provide the necessary ecological information resulting from a sea level canal in Central America.

Dr. GALLER. Yes, sir.

Mr. ROGERS. I wonder if enough work is being done in this area.

Dr. GALLER. Speaking as a scientist-administrator who has over the past 20 years been associated with program development, and speaking without prejudice or criticism of any group, it is my considered opinion that if such basic research is going on that would help us assess what might occur as a result.

Mr. ROGERS. It will be helpful to have your suggestions in this.

I think it would be helpful to have your remarks extended for the record.

(The material follows:)

BASE LINE STUDIES IN THE REGION OF THE INTERAMERICAN ISTHMIAN CANAL

The effects of some of the activities of modern man which can change the distributions of animals and plants and the geography of major regions of the world may be of the greatest scientific and economic (and therefore political) importance.

Many examples can be cited: The construction of a canal around Niagara Falls permitted the sea lamprey to invade the Great Lakes, and destroyed important lake trout and whitefish industries. The accidental introduction of a snail parasite on Japanese oysters contributed to an equally great reduction in the major ground fisheries of the Black Sea. The digging of the Suez Canal has allowed 137 species of marine organisms to pass from the Indian Ocean to the Mediterranean Sea, and at least one species to pass in the reverse direction. The ultimate repercussions of this exchange are not yet clear, but already the preliminary effects are being felt from Pakistan to Tunisia. Dams in inland waterways of the western United States have prevented the reproduction of salmon. On land, there are the famous examples of rats, starlings, and sparrows introduced into North America, and rabbits and cacti introduced into Australia. All these species have wrought basic changes in the ecologies of their new homes, and some have already cost many millions of dollars to control.

These examples indicated that the construction of a new sea level canal in Panama or Colombia should be accompanied by a wide range of biological studies. First of all, preliminary information must be obtained in order to predict the probable biological effects of the mixing of Atlantic and Pacific biotas. The subsequent changes in the biological and physical environments should be monitored and measured regularly, for a period of several years.

The information obtained would be of great scientific interest as well as practical value.

The Atlantic-Pacific Interoceanic Canal Study Commission is making radiobiological studies to determine the feasibility of canal construction. Following the Commission studies, a decision will be made as to whether to undertake construction. The Smithsonian Institution is an appropriate organization to direct or coordinate the long-term studies. The following proposal specifies the precise interests of the Institution, summarizes its resources and capabilities, and suggests a definite program to begin the necessary research as rapidly and economically as possible.

RELATIONSHIP TO PREVIOUS WORK

The studies which the Smithsonian proposes to undertake would complement and supplement the earlier work sponsored by the Atlantic-Pacific Interoceanic Canal Study Commission. The Smithsonian would extend the Commission's feasibility studies in space and in time to investigate each major habitat type on each side of the canal over a period of time sufficient to achieve a biological understanding of the dynamics and ecology of the organisms and not just their occurrence.

Current plans for the investigation of the feasibility of and the most suitable site for a sea level canal between the Atlantic and the Pacific Oceans are proceeding in a way which suggests that a new canal may be opened before the turn of the century. Under Public Law 88–609 the President appointed the Atlantic-Pacific Interoceanic Canal Study Commission and charged them with the responsibility to make a full and complete investigation and study of this possible seaway. For the Canal Commission the Nevada Operations Office of the Atomic Energy Commission contracted with the Battelle Memorial Institute to manage bioenvironmental studies designed to determine the radiological-safety feasibility of using nuclear explosives to excavate the canal. Battelle's management responsibilities included the acquiring, evaluating, and interpreting of data needed "to predict the potential exposure of man and other important species to external and/or internal radiation." Originally charged with completing its studies by June 30, 1968, the Commission has requested additional funds to continue the authorized feasibility, site selection, and construction method studies through December 31, 1970.

The probable radiation effects, if nuclear cratering techniques are employed, would be expected to be small and short-lived by comparison to the effect of a totally marine connection between the two oceans. The excellent studies now underway by the Battelle Memorial Institute should provide information relative to nuclear radiation. The importance of the Smithsonian studies is entirely independent of the means of canal construction.

It is proposed that the Smithsonian assure the development of an adequate program to permit the fullest possible understanding of: (1) the implications of new canal construction for the distribution and maintenance of marine life, (2) the extent of movement through the existing canal, and (2) the necessary background to evaluate any oceanographic changes which might occur after a sea level connection is made.

Extrapolating from the observed morphological diversity we can expect that, after the sea level canal is completed and the barrier to dispersal is removed, a wide range of changes may occur. The influx of new organisms would be expected to upset the balance of some populations. New interactions among species would change the nature of the selection to which the organisms are subjected. Instances of hybridization and intergradation can be predicted among those related groups from opposite sides of the Isthmus which have not accumulated sufficient genetic or behavioral isolating mechanisms. In some circumstances competition between newly mixed elements of the biota may cause rapid changes in population densities. Some species probably will become more abundant, while others may become extant. New species interrelationships will occur. The possible effect on harvestable marine species is uncertain.

An innate complexity exists in biological systems in the tropics resulting from three distinctive features: (1) tropical biota includes larger numbers and a greater diversity of species than the biotas of any other regions of the world; (2) the ecological and behavioral relations between species are more complex in the tropics than elsewhere; and (3) the tropics are believed to be the place of origin, and principal center of evolution, of most groups of organisms. New and major types of adaptation to "new ways of life" appear to be more likely to be evolved by tropical species than by species of other regions. Tropical species also seem to be more successful in invading other regions than are species of other regions in invading the tropics.

As clearly established during the Smithsonian Conference on Tropical Biology held in Panama City, November 10–12, 1966, our knowledge of tropical biology lags far behind parallel information in the temperate regions. Accumulation of these data for tropical regions is essential for the development of rational programs to harvest the sea and best utilize its resources. The major areas of protein deficiency for human populations are in the tropics. Detailed knowledge of the potential fisheries resources is but one of the side benefits to be anticipated from the proposed Isthmian program.

PLAN OF RESEARCH

An evaluation of the resources in the area depends on a reasonably complete biological survey. The Institution will utilize its existing shore facilities in the area and construct others to maintain adequate local support. As necessary, it will assist in the operation of ships. Scientists from the Smithsonian and from universities, government agencies, museums, and foreign organizations will be invited to participate in the development and operation of a coordinated and complete oceanographic survey. The Institution will employ personnel and help to support the participation of scientists from Mexico, Central America, and South America as well as from North America in order to secure adequate samples of the diverse organisms present and to provide training and experience in the collection of marine specimens.

All appropriate qualitative and quantitative methods of collecting and preserving specimens will be utilized in order to provide not only for faunal and floral reports, but also for a sufficient number of specimens for use in genetic, anatomic, and ecological studies. Whenever needed, specimens will be collected in sufficient abundance to permit analyses for contained radioactive elements. The Smithsonian studies will provide for publication of field guides, monographs, and other reports essential to an understanding of the organisms of the area and their interrelationships.

The Smithsonian Institution will serve as the core agency to assemble the competencies of the many universities and government and intergovernment agencies which have had long interests in the Isthmian area. Scripps Institution of Oceanograhy, the Institute of Marine Sciences of the University of Miami, the Bureau of Commercial Fisheries, the Environmental Science Services Administration, and the Inter-American Tropical Tuna Commission are examples of groups which have contributed heavily to the knowledge of the Panama region and which have continuing programs in the area. Also the EASTROPAC program, a major cooperative research effort, is making direct contributions to Isthmian studies. Active liaison with this program has been established. In addition to its huge storehouse of collections and library facilities, the Smithsonian brings several in-house areas of competence to the proposed study.

Of great significance is the existence on the Smithsonian staff of a reservoir of competent scientists. Many of the staff members presently are engaged in problems having a direct bearing on the proposed study; others plan to initiate such studies, while still others have indicated a strong desire to serve in an advisory capacity to the program.

EXAMPLES OF SCIENTISTS AND SCIENTIFIC PROGRAMS BEARING A DIRECT RELATIONSHIP TO THE PROPOSED STUDY

A. Museum of Natural History

(1) Dr. Robert Gibbs, in cooperation with university scientists, has initiated a detailed study of a complete water column with particular regard to the distribution and ecology of fishes from both seasonal and diurnal points of view. This study currently is being undertaken in an area near the Bahamas; however, Dr. Gibbs wants to establish sampling locations on both sides of the Isthmus if funding is made available. (2) Dr. Clyde Roper, a cephalopod specialist cooperating within the existing program, would like to concentrate his activities on cephalopod populations in the same water column. Dr. Roper has had considerable experience in the area, having worked in the waters off Panama, Colombia, and Educador. His dissertation involved specimens from the Bay of Panama. (3) Dr. Thomas Bowman would like to expand his studies of copepods and hyperiid amphipods to the Isthmian area. He has recently published work on Puerto Rican species. (4) Dr. Raymond Manning has worked on the stomatopods of the area and is anxious to continue this work. (5) Dr. Meredith Jones would pursue studies of benthic ecology with particular emphasis on the polychaete worms. (6) Dr. James Peters plans studies on the marine turtles and sea snakes of the area with particular emphasis on the possible invasion of Pacific snakes into the Atlantic. (7) Dr. Ernest Lachner plans to initiate a tagging study of marine fish movement in the area. (8) Dr. Victor Springer, an expert on the blennioid fishes, has published on fishes of the Isthmian area. He would like to continue and expand his studies, especially in the inshore area. (9) Dr. Grant Gross has done considerable work on the Columbia River plume in tracing the distribution of radionuclides in the open ocean. Dr. Gross would like to develop a tracer study in the event that the proposed canal is constructed using nuclear techniques. (10) Dr. Jack Pierce, who is interested in the sediment budget of coastal areas, would like to study the bulk transport of sediments resulting from the interconnection of the two oceans. He would conduct base line studies prior to canal construction. (11) Several members of the staff of the Museum Division of Paleobiology have interests in studies of the outcroppings which will be revealed during the con-

struction period. These scientists would like to relate the findings to the paleontological history of outlying marine areas.

B. Smithsonian Tropical Research Institute

Situated in the Canal Zone, the Tropical Research Institute has laboratory space on both coasts of Panama. The marine research at the Institute is directly relevant to the studies proposed. A seawater system and large holding tanks have been renovated and are being operated near the Pacific end of the present Canal, and a capability of similar nature will soon exist on the Atlantic. Additionally, the Institute has access to several large buildings which are surplus to the needs of the Canal Zone authorities and which would make good warehouses for logistic support and preliminary processing of collections.

Examples of scientists and scientific programs in the Institute include: (1) Dr. Ira Rubinoff, who is analyzing the extent to which populations of shore fishes have evolved isolating mechanisms since the rise of the Isthmus Barrier about 7½ million years ago. Dr. Rubinoff is culturing several species of fishes from each side of the Isthmus. (2) Dr. Neal Smith conducts investigations of the reproductive biology of various marine birds. (3) Dr. Martin Moynihan has studied the behavior of marine bird species. (4) Dr. Peter Glynn, who joined the staff of the Institute in August 1967, will make quantitative studies of the ecology of benthic marine invertebrates in the Isthmian region and will compare them to his previous studies of the Puerto Rican region. (5) Mr. Robert Topp will be studying the ecology and behavior of Panamanian species of pomocentrid fishes.

C. Smithsonian Oceanographic Sorting Center

The Smithsonian Oceanographic Sorting Center (SOSC) was established to assist in the international oceanographic effort by processing biological and geological collections for scientists throughout the world. Since 1963 the Center has received and sorted collections from nearly 50 separate programs, including large portions of the material from the International Indian Ocean Expedition, the United States Antarctic Research Program, and the Guinean Trawling Survey. The success and enthusiasm with which scientists and institutions have greeted the service provided by SOSC are evidenced by the regularly increasing quantity of material received since its inception, and by the corresponding increase in the volume of requests for specimens being sorted from this material.

During the proposed study the Sorting Center would function as the receiving point for collections, their recording, sorting into discrete groups, and distribution to specialists for study and permanent storage. The wide variety and large volume of material which will be collected during the proposed study makes this service essential to the efficiency and success of the work.

As a first step in the present proposal, the Smithsonian will develop a detailed operational plan in consultation with appropriate experts from other agencies, and establish a steering committee patterned after the Committee on Environmental Studies for Project Chariot to assist in guiding the long-range program.

As part of the initial studies, the following tasks must be accomplished:

1. The geographic limits of the survey must be drawn. The migratory nature of many species requires that a much larger area be considered than just the immediate vicinity of the Isthmus. A suggestion of the possible problems involved may be seen in the recovery in Venezuela of Western Atlantic cow-nose rays which had been tagged in Chesapeake Bay.
2. The needed oceanographic data—biological, physical, chemical, and geological—necessary to establish base lines must be carefully detailed for the area. It is certain that the most intensive studies will be concentrated immediately in the Isthmian area; however, the diminution of sampling intensity with distance from the Isthmus will vary within each discipline.
3. A program of experimental studies must be developed to permit an evaluation of potential problems arising from the movement of interoceanic migration and hybridization and other effects of the ecosystem.
4. The harvestable resources of the area, both present and potential, will be determined, and necessary programs will be recommended to permit evaluation of the effect of the sea level canal on these stocks.
5. Current and past programs in the area will be evaluated and related to data requirements for the proposed study. Liaison with pertinent agencies will be established and, when practical, they will be asked to expand existing programs to provide needed data.

6. Gaps will be delineated which may exist after the above expansion, and additional professional support will be solicited to assure complete coverage.
7. Preliminary examinations of the selected survey areas will be conducted to assure that appropriately representative sites have been chosen.
8. A project director, with appropriate supporting staff, will be employed to coordinate the project, write project plans, provide advice to the steering committee, and to conduct preliminary studies.

Mr. EDWARDS. May I ask a question along that line. Is there some fear in your mind that, if we develop a sea-level canal, some grave consequences may come about? Is that a serious problem?

Dr. GALLER. It could be a very serious problem. I do not subscribe to the alarmist views that some of my colleagues have, but by the same token I can sympathize with their views by virtue of the fact that we just do not have enough fundamental data at hand to be able to project what could occur if the oceans were linked by an interoceanic, sea-level canal. The evidence to date in such areas as the Suez Canal and the Black Sea and, more recently, the Aswan Dam, suggests very strongly that there are profound changes that do occur in the water masses adjacent and considerably beyond these new major engineering developments.

Whether in fact one could project what might occur if there were a sea level canal, I am not prepared to say, but I am prepared to offer a strong recommendation that it would be in our national best interest to undertake a long-term fundamental research program that would cooperate in and support what we are trying to do in developing an interoceanic canal.

Mr. EDWARDS. Thank you.

Mr. ROGERS. Mr. Keith, do you have any questions?

Mr. KEITH. Thank you, Mr. Chairman.

Dr. Galler, how do the Smithsonian Institution's plans to make detailed studies of the structure and movement of the earth's crust on the ocean floor relate to plans of the Scripps Institution of Oceanography to make similar studies?

Dr. GALLER. Smithsonian scientists work on these projects jointly with Scripps Institution of Oceanography. Drs. T. J. Van Andel of Scripps and William G. Melson of the Smithsonian share deep ocean research interests, with Melson specializing in the mineralogy of the rocks collected and Van Andel in the sedimentology of the soft material. The techniques used for study and the information gained are complementary. Such collaboration may include joint cruises or separate cruises. In the latter case, one scientists saves appropriate collections for the other.

In the now defunct Project Mohole, the Smithsonian Institution scientists—in this case, Dr. Melson—would have served as chief scientist for portions of the Scripps-organized experiment. During the long coring project of the National Science Foundation, that part of the project funded through the Scripps Institution of Oceanography includes Dr. Melson in the coordinating group concerned with minerals on the sea floor. Of course, the same mechanism for coordination exists in the Atlantic.

Mr. KEITH. How does the Smithsonian Institution expect to contribute to solving the problem of data handling procedures and standards for exploration of the ocean?

Dr. **Galler**. The problems concerned with procedures and standardization of data collected during oceanic explorations are normally and necessarily difficult. The Smithsonian Institution is participating in national and international committees to move toward standardization. With less than 10 percent of the ocean explored however, we still are not able to make good recommendations in selecting techniques to standardize. Using the existing nets, trawls, traps, snag lines, et cetera, we may catch some or none of a species of organisms which appear in large numbers in the stomach of birds, fishes, whales, and seals feeding in the collection area. We clearly have yet to invent a device which will sample the ocean adequately.

After that happens we will want to standardize it. Now we are equally interested in taking advantage of inventive genius in standardizing useful data handling devices.

In direct response to your question then, we are moving with vigor to assist in standardizing and comparing the existing methods of data storage and retrieval, and at the same time we are giving all possible encouragement to the conceptualization and design of new techniques for gathering data.

Mr. **Keith**. Thank you, Dr. Galler.

No more questions, Mr. Chairman.

Mr. **Rogers**. Counsel, do you have any questions?

Mr. **Drewry**. Yes, Mr. Chairman.

What is the present status of the North Pacific Ships of Opportunity program?

Dr. **Galler**. Mr. Counsel, may I refer this to Dr. Aron?

Dr. **Aron**. Just 3 days ago we received information from Dr. Bates, of the Navy, indicating that—yes, indeed, the Navy felt our work was technically very meritorious. However, in view of their present budget commitment, it was impossible to provide fiscal support. As a result, our enthusiasm and our interest in the program continues very strongly, but we are unable to perform in the coming year due to lack of funds. We would hope in future years we will be able to perform, but it depends, really, primarily upon adequate fiscal support. The manpower is available to us. The interest is available to us.

Mr. **Drewry**. It must be deferred for the time being.

Dr. **Aron**. It must be deferred.

Mr. **Drewry**. Perhaps for the benefit of the record you could submit a brief statement outlining the project that you had in mind.

Dr. **Aron**. We would be very happy to do this.

Mr. **Drewry**. Thank you, Mr. Chairman.

(The material follows:)

Department of the Navy,
Office of Naval Research,
Washington, D.C., September 8, 1967.

Mr. James Bradley,
Acting Secretary, Smithsonian Institution,
Washington, D.C.

Dear Sir: Your proposal entitled "Productivity of the North Pacific," dated 15 May 1967, originally made to the Oceanographer of the Navy has been forwarded to this Office for action.

We have reviewed your proposal and concur in the technical desirability of the work proposed therein. However, in view of our assessment of the relative priority of program efforts and the funding expected to be available this fiscal year, we will not be able to fund this effort.

Your interest in the Navy's problems is appreciated.

Sincerely yours,

H. A. O'NEAL,
Director, Ocean Science and Technology Group
(By direction of Chief of Naval Research).

PROPOSAL TO OFFICE OF THE OCEANOGRAPHER OF THE NAVY

1. *Name and Address of Institution.*—Smithsonian Institution, Washington, D.C. 20560.

2. *Principal Investigator.*—Dr. William I. Aron, Deputy Head, Office of Oceanography and Limnology.

3. *Title of Proposal.*—Productivity of the North Pacific.

4. *Desired Starting Date and Time Period.*—September 1, 1967 for one year.

5. *Summary.*—The Smithsonian Institution in cooperation with the University of Washington and the Fisheries Research Board of Canada proposes a series of 24 transects of the North Pacific Ocean using merchant ships to obtain data to develop a model of phytoplankton production. These cruises would obtain data on standing crop of plankton, vertical temperature profiles, solar radiation, salinity, and temperature. The data would be related to information being collected at Canadian Ocean Weather Station "P" and in addition would be made available to the Navy for their ocean prediction and biological programs and also to pertinent studies in the Bureau of Commercial Fisheries.

6. *Background.*—The feasibility of using merchant ships for gathering oceanographic data has been well demonstrated; in fact, programs are currently in progress at the Naval Oceanographic Office and the Bureau of Commercial Fisheries which depend on the data gathering capabilities of "Ships of Opportunity." These studies are aimed primarily at descriptions of the physical environment, and with the exception of work being pursued in the North Sea by the United Kingdom, little biological information is being collected by merchant ships.

The Smithsonian Institution proposes, in cooperation with the University of Washington and the Fisheries Research Board of Canada, to undertake a research program, utilizing merchant ships during their transects of the North Pacific, to collect both biological and physical data for developing a model to predict the timing of the spring phytoplankton bloom. The need for the development of critical indices of primary and secondary production was discussed by T. R. Parsons and R. J. LeBrasseur, in a paper presented at the Symposium on Large Scale Ocean Surveys at San Diego in 1965. The development of such indices would simplify the observations required during large scale surveys and thus increase operational efficiency and reduce costs. To develop models, however, more time series and synoptic data are required than can be presently attained through the use of oceanographic research vessels.

This work will be accomplished in close cooperation with the AEC sponsored University of Washington study of the "Columbia River Effects in the North Pacific" and with the Canadians studies at their Ocean Weather Station "P."

By being able to sample regularly during all times of the year, including the winter, it is expected that the study will provide new insight on seasonal changes and on the influence of physical and chemical features on the biota of the North Pacific.

7. *Procedure.*—One round trip crossing per month (24 transects during the year) between Seattle and Yokohama is planned. Each transect normally follows the Great Circle Route and takes about 10 days.

A team of 5 technicians will be assigned to the program. They will be rotated to permit their involvement in all stages of the work both at sea and ashore. When scheduling permits it is anticipated that suitable arrangements can be made to allow them to accomplish initial data processing while waiting in Japan for the return trip to Seattle.

At the start of each cruise Dr. George Anderson of the University of Washington or one of his associates will brief each new participant and either he or his representative will accompany the ship from Seattle to Port Townsend (where he will disembark with the pilot) to assure that all systems are functional and that rigid standards are maintained throughout the program.

The following observations will be taken every 6 hours:

(*a*) Phytoplankton sample-collected on a millipore filter from water tapped from the main injection. Plant pigment analyses will be made on these samples to provide an estimate of phytoplankton standing crop.

(*b*) Zooplankton sample-filtered from main injection, preserved in formalin. Volumetric analyses will be run to estimate zooplankton standing crop and the abundance of important species determined to evaluate seasonal and geographic changes in the catch.

(*c*) Nitrate and silicate sample-either from main injection or a surface sample. Sample will be frozen, and chemical analysis will be performed ashore.

(*d*) Radiation reading—with deckside photocell.

(*e*) Expendable Bathythermograph (XBT) observation to determine mixed layer depth and vertical temperature distribution.

(*f*) Surface temperature and main injection temperature.

(*g*) Surface salinity sample.

In addition to these measurements, the installation of a continuously recording salinograph/thermograph in the main injection is planned. The use of this instrument will permit detection of transitional regions and allow for increased sampling intensity in these areas.

The field portion of the program can be accomplished by two technicians. The Smithsonian will provide the senior technician for every cruise and the second man as well, whenever necessary. On occasion, the second position will be taken by a representative of the University of Washington or of the Fisheries Research Board of Canada and in some cases, a Merchant Marine cadet or other trainee will provide support.

It is anticipated that chemical analyses and data reduction will be performed at the Smithsonian. However, some processing, particularly the computer analysis, may be more effectively carried out at the University of Washington.

Data interpretation will be accomplished at the Smithsonian in close cooperation with Dr. G. Anderson and Dr. T. R. Parsons of the Fisheries Research Board of Canada, with particular emphasis placed on relating data obtained during this program to the time series observations made at the Canadian Ocean Weather Station "P" (50°N, 145°W) and to the University of Washington, Columbia River program and other data taken by oceanographic research ships operating in the area.

It is anticipated that the results of this study will be published in an appropriate scientific journal.

The cruises will employ ships of the American Mail Line. Their President, Mr. Worth Fowler, has assured all reasonable cooperation. It should be pointed out that the success of the first ONR sponsored "Ship of Opportunity" cruise aboard the SS *Java Mail* was in large part due to the splendid cooperation of Mr. Fowler. It is planned to use "Mariner" class ships for the work. These ships normally cruise at about 21 knots.

All of the samples, with exception of the zooplankton, are capable of rapid analysis by the technicians to be employed and of reduction by machine techniques. It is anticipated that this will permit completion of a report on the cruises within two months of the final transect in the series.

8. *Relationship to Other Programs and National Objectives.*—The data collected during the proposed program will have considerable significance to other areas. Pertinent data will be supplied to:

(*a*) The Naval Oceanographic Office sea prediction projects. As far as possible the data from the XBT's will be transmitted on a real time basis.

(*b*) The Naval Oceanographic Office for their biological studies.

(c) The Bureau of Commercial Fisheries for—

(1) their project at Stanford concerned with relating long term large scale oceanographic changes to fishery resources,

(2) their Seattle oceanographic laboratory which is primarily concerned with the salmon fisheries.

(*d*) The Intergovernmental Oceanography Commission study of the Kuroshio current.

(*e*) The North Pacific weather studies by the Environmental Sciences Services Administration.

In addition to these immediate aims are the long term goals of the proposed study which are relatable to several national objectives.

The development of a suitable model for primary production is a major step toward developing a fundamental understanding of the food resources of the sea.

If successful, the proposed program can be expanded to other areas thus permitting the predictive mapping of potential food resources in the world ocean.

The routine collection of environmental data by merchant ships contributes significantly to the capability of forecasting of ocean conditions and is a rapid and relatively low cost technique for expanding the oceanographic competence of the United States.

The use of merchant ships for gathering routine survey data will permit the more effective use of the specialized oceanographic research ships. By obtaining regular information in areas that are presently either unsampled or are inadequately sampled new questions will be uncovered and better insight obtained to understanding oceanographic processes.

10. Budget

Personnel compensation:	
Principal investigator (direct salary borne by SI) Technicians (5)	$33,670
Personnel benefits	3,367
Travel and transportation of persons:	
Air fare, economy class, District of Columbia to Seattle, 24 round trips, at $275	6,600
Per diem:	
En route to Seattle and return, and for pre- and post-cruise work, 72 at $16	1,152
Stopovers in Japan between cruises, 200 at $18	3,600
Local travel to and from airports, excess baggage charges, etc., 24, at $25	600
Ship fare, Seattle to Yokohama, 24 round trips, at $500 ($25 per day per estimated 20-day trip)	12,000
Per diem on board ship, 24 at $58 per trip	1,392
Total	25,344
Supplies and materials:	
Expendable BT's, 1,200, at $21	25,200
Filters, photocells, pumps	5,000
Total	30,200
Equipment:	
2 sets, launchers and recorders, at $3,000	6,000
2 salinograph/thermographs, at $5,350	10,700
Total	16,700
Total direct costs	109,281
Overhead	41,527
Total costs	150,808

The Smithsonian Institution is an "Establishment" which is under a Board of Regents. The Institution proper, as distinguished from a number of Government Bureaus that have been committed to its administration by the Congress, is a private corporation under the guardianship of Congress.

The Institution therefore assumes a dual role, being both private and Governmental. It performs research projects for other Government agencies as an educational institution under the cost principles of the Armed Service Procurement Regulations, Section 15.3.

11. *Institutional Approval:*

WILLIAM I. ARON,
Deputy Head, Office of Oceanography and Limnology.
I. E. WALLEN,
Head, Office of Oceanography and Limnology.
SIDNEY R. GALLER,
Assistant Secretary (Science).
JAMES BRADLEY,
Acting Secretary, Smithsonian Institution.

BIBLIOGRAPHY OF WILLIAM ARON, DEPUTY HEAD, OFFICE OF OCEANOGRAPHY AND LIMNOLOGY, SMITHSONIAN INSTITUTION

Education

Ph. D., Fisheries-Oceanography, 1960, University of Washington.

Dissertation on the distribution of marine animals in the Northeast Pacific.

M.S., Fisheries-Genetics, 1957, University of Washington.

B.S., Biology-Genetics, 1952, Brooklyn College.

Experience

1956–1961 University of Washington, Department of Oceanography, Research Assistant Professor.

Carried out ecological and zoogeographic studies in the Northeast Pacific, including participation with the Department in Project Chariot.

As a member of a Working Group of the Committee on Oceanography, National Academy of Science-National Research Council, took part in developing a program for the disposal of low-level radioactive waste into Pacific coastal waters.

Organized and served as chairman of a symposium on the Biological Implications of Radioactive Isotopes in the Sea, at the University of California, Davis, June 1961.

1961–1967 GM Defense Research Laboratories Head, Biological Oceanography Group.

Served as chairman and also assisted in the organization of a symposium on Plankton Sampling and Biomass Assessment, Stanford University, June 1963.

As a member of a Working Group of the Biological Methods Panel of the Committee on Oceanography, National Academy of Science-National Research Council, is actively participating in a program for the evaluation of plankton sampling techniques.

1956: Food of salmonid fishes of the North Pacific Ocean: (c) Pink Salmon O. *gorbuscha:* (d) Preliminary comparative study of the feeding behavior of the Pink, Sockeye and Chum salmons. Univ. of Wash., Dept. of Oceanography, Fish. Rept. 4.

1957: Food of salmonid fishes of the western north Pacific Ocean. U.S. Fish & Wildlife Service, Sp. Scientific Rept. 237 (with George H. Allen).

1958: Preliminary report of midwater trawling studies in the North Pacific Ocean. Univ. of Wash., Dept. of Oceanography, Tech. Rept. 58. (Appendix with Peter McCrery).

1958: The use of a large capacity portable pump for plankton sampling, with notes on plankton patchiness. Univ. of Wash., Dept of Oceanography, Tech. Rept. 59.

1958: Cytological and Histological studies on the hybrid of *Platichthys stellatus X Parophrys vetulus*, with notes on its backcross to to *P. vetulus.* Copeia, 2:–105–111.

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1959: Midwater trawling studies in the North Pacific. International Oceanographic Congress, American Association for the Advancement of Science. 302–303.

1960: The distribution of animals in the eastern North Pacific and its relationship to physical and chemical conditions. Univ. of Wash., Dept. of Oceanography, Tech. Rept. 63.

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1962: The distribution of animals in the eastern North Pacific and its relationship to physical and chemical conditions. J. Fish. Res. Bd. Canada 19(2) : 271–314.

1964: A description of a discrete depth plankton sampler with some notes on the towing behavior of a 6-foot Isaacs-Kidd mid-water trawl and a one-meter ring net. Limnology & Oceanography 9 (3) : 324–333.

1965: Towing Characteristics of Plankton Sampling Gear (W. Aron, et al.). Limnology & Oceanography 10(3) : 333–340.

1966: Improvements in the discrete depth plankton sampler system. Limnology & Oceanography 11(3) : 422–426. Aron, et al.)

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1957: A report for the General Petroleum Corporation on the intertidal beach zone in the vicinity of the Ferndale, Washington refinery. (Consultation with Robert O. Sylvester).

1962: A survey of the oceanographic literature of the Santa Barbara Channel area. Prepared under U.S. Atomic Energy Commission Contract No. AT(11–1)–1145. GM Report No. TR62–215. (W. I. Aron, et al.).

1965: Report on Ships of Opportunity Program, Preliminary Feasibility Study. Prepared under Office of Naval Research Contract No. Nonr–4742(00). GM Report No. TR65–18.

1967: Acoustical and Biological Studies of the deep scattering layer in the Eastern North Pacific. Prepared under U.S. Naval Oceanographic Office Contract No. N–62306–67–C–0001 and Office of Naval Research Contract No. 4742(00). AC Electronics-Defense Research Laboratories TR67–13.

Books

1959: Waterfoods, Vol. 1 & 2. U.S. Army Medical Service, Meat and Dairy Hygiene School. (With Malcoln (Scott) McLeod & Gunnar Rollefsen).

Members of a working group of the Plankton Committee of the International Council for the Exploration of the Sea for the standardization of plankton methods.

Served as Chief Scientist of Project Neptune, an Office of Naval Research sponsored study to determine the feasibility of using American merchant ships for making oceanographic measurements.

As Head of the Biological Oceanography Group is responsible for developing and supervising the implementation of a field and laboratory program primarily aimed at improving sampling techniques to permit a better understanding of the bioenvironment and populations in the sea.

March 1967—Smithsonian Institution, Office of Oceanography and Limnology, Deputy Head.

Directs studies of ecology and zoogeography of zooplankton and micronekton, and the applications of modern instrumentation to biological sampling.

Mr. ROGERS. This would be funded by another agency. Basically, what Federal funds do you actually obtain and in what areas? You have about $1.8 million for oceanographic work?

Dr. GALLER. No, sir. This is our hope and aspiration, but in point of fact, unless you define oceanography at its very broadest, the Office of Oceanography right now, I think, is limited to about $100 thousand-plus; is that correct?

Mr. ROGERS. This report indicates you have estimated $1.6 million, and the President's budget for 1968 would allocate $1.8 million. Is that correct?

Dr. GALLER. May I ask Dr. Aron to comment on that?

Dr. ARON. I think I can explain this. Included in those figures are the actual salaries for the 70 or so scientists on the Smithsonian staff who are directly involved in marine research programs.

Mr. ROGERS. Do these come from the budget?

Dr. ARON. These come from the budget.

Mr. ROGERS. That is the real figure.

Dr. ARON. That is the figure. Our own office, which includes the operation of the Smithsonian Oceanographic Sorting Center, has a substantially lower budget, something on the order of $200,000.

Mr. ROGERS. For operation?

Dr. ARON. For operation.

Mr. **Rogers.** Other than salary?

Dr. **Aron.** No; that includes salary. That includes salary of the technicians.

Mr. **Rogers.** Is your salary included in this $1.6 million overall figure?

Dr. **Aron.** Yes.

Mr. **Rogers.** Do you make any request for a project like "Ships of Opportunity" when you want to participate in them?

Dr. **Aron.** Yes, we do. It would be the hope in the future that we could get funding directly.

Mr. **Rogers.** Have you made such requests for direct funding?

Dr. **Galler.** Mr. Chairman, we have made a request. I think Dr. Aron referred, in mentioning the Navy's position, to a proposal that has been submitted from the Smithsonian Institution to the Navy soliciting support for the Ships of Opportunity project.

Mr. **Rogers.** It might be well if you let us have information as to what programs you are submitting and the funding asked.

Are there any other questions? If not, we are very grateful to you, Dr. Galler and Dr. Aron, for being here. The committee will adjourn until 10 o'clock tomorrow morning.

(The subcommittee adjourned at 12:10 p.m.)

NATIONAL MARINE SCIENCES PROGRAM

FRIDAY, SEPTEMBER 22, 1967

House of Representatives,
Subcommittee on Oceanography of the
Committee on Merchant Marine and Fisheries,
Washington, D.C.

The subcommittee met, pursuant to recess, at 10:10 a.m., in room 1334, Longworth House Office Building, Hon. Paul G. Rogers presiding.

Mr. Rogers. The committee will come to order.

Our first witness this morning is the distinguished Senator from the State of Rhode Island, the Honorable Claiborne Pell.

STATEMENT OF HON. CLAIBORNE PELL, A U.S. SENATOR FROM THE STATE OF RHODE ISLAND

Senator Pell. Mr. Chairman and members of the committee, I am most grateful to you for allowing me the chance to submit my views on the current status of the national sea-grant program.

As you know, it will be necessary shortly to reauthorize the continuation of this program through legislative action. I propose to offer a bill for this purpose in the near future.

Meanwhile, I would like to say now how pleased I am to note the overwhelming, countrywide interest in this program for developing our marine resources. I understand that, although the final criteria for submitting proposals were published only this month, institutions from many States have already submitted about 400 informal requests for grants as soon as the program gets underway.

May I say on this point that I believe Robert Abel, the program's director, and his capable deputy, Harold Lee Goodwin, deserve a lot of credit for this large number of specific requests. They have gone from institution to institution around the country in response to inquiries from State governments, State universities, and oceanographic institutions. Through their own expertise and imagination they have effectively dramatized the sea-grant program to all sorts of potential users.

Despite these good aspects of the program, now in its second fiscal year, I am concerned by the fact that to date not one single grant has yet been made. The delay has been understandably caused by the administrative work necessary to develop the practical mechanism within the National Science Foundation for carrying out the provisions of the act.

The excellent booklet, which NSF has developed for promulgating the criteria for proposal submissions, has now been distributed, and action should start shortly. Nevertheless, I am worried lest inadequate funds make it impossible to provide enough grants to maintain the interest of the large number of oceanographic institutions which want to participate at this time.

Mr. Chairman, since all of you on the Oceanography Subcommittee are committed to the development of our Nation's marine resources, I hope we can work together for legislative authorization to continue this program, and for adequate appropriations for this vital and exciting plan for pushing back the frontiers of inner space.

Mr. Rogers. The subcommittee is grateful for your statement, Senator, and we sincerely appreciate your appearance here this morning.

Senator Pell. Thank you, Mr. Chairman.

Mr. Rogers. We have as our next witness, Dr. Robert H. White, Administrator of the Environmental Science Services Administration, in the Department of Commerce.

Dr. White, we are delighted to see you again and the committee will be pleased to receive your testimony. Will you identify your colleagues for the record, please?

STATEMENT OF DR. ROBERT M. WHITE, ADMINISTRATOR, ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION, ACCOMPANIED BY ADM. DON JONES, ASSOCIATE ADMINISTRATOR, AND ROBERT B. ELLERT, ASSISTANT GENERAL COUNSEL, DEPARTMENT OF COMMERCE

Dr. White. Thank you, Mr. Chairman.

I have with me today, Adm. Don Jones, the Associate Administrator of the Environmental Science Service Administration, and Mr. Robert B. Ellert, the Assistant General Counsel for the Department of Commerce.

Mr. Rogers. We are delighted to have them present.

Dr. White. Mr. Chairman and members of this subcommittee, I am honored to appear here and to discuss with you the marine program of the Environmental Science Services Administration, Department of Commerce, as it relates to the activities of the National Council on Marine Resources and Engineering Development established by section 3 of the Marine Resources and Engineering Development Act of 1966. ESSA was established under Reorganization Plan No. 2 of 1965 to bring under one head the Commerce Department's environmental activities.

Its mission is to understand, describe, and predict the geophysical environment in support of such vital national goals as public safety, enhancement of the economy and assistance to other Federal agencies concerned with defense, space exploration and natural resources. These elements of ESSA's broad responsibility all contribute to and support directly the goals of the long-range national program in marine science as established last year by the act, specifically, protection of health and property; enhancement of commerce, transportation, and national security; rehabilitation of our commercial fisheries; and increased use of these and other resources.

The marine environment is a major concern to ESSA. Two of our components, the Coast and Geodetic Survey and the Weather Bureau, have long traditions of national service in this area; the Survey for 160 years in mapping and charting the oceans, and the Weather Bureau for 100 years in the provision of marine weather services. Our other components are deeply involved in the use of satellites for oceanographic observations, and the conduct of research on a wide range of oceanic processes, an understanding of which is vital if we are to remove scientific limitations on our ability to render new and improved marine services. Man's environment is global and indivisible. The ocean is an integral part of this global environment and cannot be understood, predicted or controlled unless its interactions with the air above and the earth below are simultaneously observed and comprehended. To appreciate this fundamental fact we need only realize that the hurricane is a creature of the ocean maintained by its warm waters and the energy it receives from condensing water vapor drawn from the oceans. The ocean current systems are maintained by the winds of the atmosphere. Tsunamis, those devastating seismic sea waves, are generated by submarine earthquakes. In a real sense the oceans control our weather, and the problems of drought and long-range weather forecasting and weather modification can be understood and solved only if we observe and understand the oceans.

In just as real a sense, our ability to operate in the oceans, to develop its resources, control its pollution, and to use it for transportation, is controlled by the capricious atmosphere through its effects on the sea state, and its current systems. A substantial number of our 11,000 employees are actively engaged in one aspect or another of marine science and service. They operate our ships for survey and research activities in the oceans, our coastal and ocean tide gage and seismic stations, our coastal radars, and marine weather stations, our operational environmental satellite system as well as our aircraft. And here we encounter another imperative: If we are to observe, understand, and be able to predict and ultimately control important aspects of our marine environment, it will be necessary to bring to bear in a comprehensive and unified manner all of our observational and communication technology both old and new to place the restless seas under suitable surveillance in a systematic and economical manner.

The services and research undertaken by ESSA are among the most essential and vital if this Nation is to make effective use of the sea. The products provided by ESSA are used by all who would operate in the seas, whether the goal is mineral explorations, development of the sea's living resources, safe transportation, prediction of the weather, or achieving an understanding of its processes.

Absolutely fundamental to the national move seaward to explore the world's last frontier, is the need to provide maps and charts of the ocean bottom and the geophysical and oceanic characteristics important to such exploration.

MAPPING AND CHARTING

ESSA's hydrographic and ocean survey program, executed by the Coast and Geodetic Survey and the Institute for Oceanography, is directed toward this objective. Our target in cooperation with other Federal agencies is the completion of charting of the depths and topography of the ocean floor where the Nation has an interest; the delineation of major ocean currents; and the completion of geophysical studies of the Continental Shelves, and of the estuaries and other coastal features of the Nation's shoreline.

ESSA publishes approximately 800 different nautical charts to cover the 2½ million square miles of the Nation's navigable waters. Some 2 million are printed and distributed annually, at modest cost; and we are continually revising and reissuing charts to account for changes which could affect navigational safety for commercial and recreational uses. An important new effort of our marine program is directed at the publication of bathymetric maps, graphic representations of underwater topography, for the development of the Continental Shelf and ocean floor.

The hydrographic program produces physical measurements and charts not only of oceans but other waters, along with their marginal land areas. As a result, charts are maintained of coastal areas including harbors and estuaries. Charts are also produced for recreational boating on nearshore waters, inland lakes, reservoirs and waterways for which other Federal agencies have not been assigned responsibility. Standard nautical charts are supplemented with a series of U.S. Coast Pilots, providing information on navigation, regulations, landmarks, channels and anchorage peculiarities, meteorological information, ice conditions, freshets, routes, pilotage, and port facilities.

Our shoreline mapping programs employ Coast and Geodetic Survey aircraft and metric cameras for the production of high quality, tide-controlled, infrared photographs permitting accurate delineation of the shoreline and legal boundaries.

WARNING AND PREDICTION

The marine environment confronts man on both land and seas with an unusually wide variety of danger and disaster—the hurricane, the storm surge, the tsunami, ice, sudden winds, torrential rain are only a few. Thus ESSA's forecast and warning services are central to the Nation's marine existence.

The life, safety, and economic well-being of many millions of persons depend upon the successful performance of these complex and challenging tasks. And incidentally, the recent incidents we have had with Hurricane Beulah in the past few days is a very good example. The most sophisticated of equipment and techniques—satellites, radar, buoys, complex communications systems, and numerous specialized services—are used to the fullest extent possible to help keep the mariner and coastal dweller safe. ESSA has begun to implement the recommendations of an interagency group relating to a natural disaster warning system, an important part of which relates to tsunamis and hurricanes.

ESSA's operational environmental satellites are providing almost complete global coverage of cloud cover, as well as of large-scale ice concentrations, over the oceans. They make possible rapid global data collection and communication. Our plans are to use this operational satellite system to acquire ocean observations as well. Global sea-surface temperature measurements and large-scale ocean currents, and other sea surface characteristics, could be observed by using the existing satellite vehicles.

Our coastal radar system finds and tracks ocean storms, and represents a critical and indispensable protective network for hurricane warnings. Special observations from the cooperative hurricane networks along the Atlantic and gulf coasts as well as our tide gage networks play major roles in our national hurricane warning service.

ESSA strives constantly to get up-to-date information to as many mariners as possible. This is accomplished through it own broadcast system, those of other public agencies, and other media. Visual displays at more than 550 stations also warn of approaching storms. In the offing are broadcasts of weather maps and prognostic charts by radio facsimile to ships on the high seas.

Our marine environmental prediction services may be divided into four broad categories: high seas shipping, Great Lakes marine activities, commercial fishing, and marine activities within coastal waters and inland waterways.

Marine weather and sea-state warnings, forecasts and reports are prepared and broadcast daily from coastal points to merchant shipping.

Forecasts, warnings and weather summaries are issued routinely for each of the Great Lakes. In the spring, the Weather Bureau office at Detroit predicts the opening date for free-ice navigation into eight principal ports: Detroit, Alpena, Cleveland, Marquette, Sault Sainte Marie, Green Bay, Duluth, Buffalo.

Support to commercial fishing is offered through 6-hourly general-area forecasts by Weather Bureau offices as Boston, Washington, Miami, New Orleans, and San Juan. These include wind direction and speed, weather, visibility and, when necessary, sea-state conditions.

Weather forecast and warning bulletins are issued at 6-hour intervals for coastal waters up to 50 miles offshore. They are broadcast by the Coast Guard, marine radiotelegraph and radiotelephone shore stations, and more than 2,000 commercial radio and television stations. Dissemination is also provided by nine new ESSA VHF–FM marine weather broadcast stations: Miami, Honolulu, San Francisco, New York, Chicago, Washington, Corpus Christi, Galveston, Jacksonville. Stations at New Orleans and Lake Charles, La., are to be installed momentarily. These are continuous broadcasts of vital information. A total of 19 will be operating within the next year and one-half.

Hurricane and tropical weather outlook reports, and poststorm reports, are issued by the National Hurricane Service from Miami, Washington, Boston, New Orleans, San Juan, San Francisco, and Honolulu. They include information on amounts of flooding expected, wave action, or beach erosion.

Such storms can raise sea level far above normal height as they approach the coast. To assist in prediction of the storm surge, ESSA has remoted and automated tide transmitting equipment on a number of gages and recorders in 14 offices. Tide observations are available on request from 115 other tide stations along the gulf and Atlantic coasts.

The tsunami, or seismic sea wave, caused by undersea seismic phenomena, can produce lethal waves which can crest at over 100 feet. Tsunamis are relatively rare but extremely dangerous. Honolulu is the hub of our national tsunami warning system and also serves to provide warnings internationally to all countries in the Pacific basin. Effective warnings depend on ESSA's and other nations' network of seismic and tide stations throughout the Pacific. To improve local warnings, regional networks are being established. Only last month ESSA dedicated its new local warning system for Alaska based on Palmer, Alaska.

Nearly all marine interests need astronomic tide calculations, tidal characteristics and long-term sea level trend predictions. They are used for navigational safety, in-shore operations and in the determination of coastal boundaries, as well as in design and planning of shoreline and offshore structures.

ESSA's network of tide gages enables it to calculate and publish the times and heights of high and low waters for 54 primary American stations and for 39 stations in 18 nations and U.S. trust territories. As required, tides can be computed for approximately 6,000 secondary locations.

Observations from temporary tidal current stations are used to predict average tidal currents and for circulation studies of tidal estuaries. Predictions are made of the times of slack waters and the times, speeds, and directions of maximum tidal currents for 25 U.S. coastal and harbor stations. Similar predictions can be made for about 2,000 additional locations.

ESSA is also embarking upon a program of providing estuarine flushing forecasts for the use of other agencies concerned with water pollution. This will utilize the output from ESSA's present programs of astronomical tide predictions, tidal currents, riverflow, and wind forecasts.

COOPERATION—INTERAGENCY AND INTERNATIONAL

The marine programs of ESSA are intimately connected to those of other Federal agencies and foreign governments. Collaborative efforts with other agencies and Government is essential for the accomplishment of ESSA's mission. International arrangements through the World Meteorological Organization and the Inter-governmental Oceanographic Commission enable ESSA and other Federal agencies to obtain ocean and weather observations from foreign countries. Observations from 800 merchant ships are received daily; seismic data and tidal data are received routinely. On the national scene we participate closely in joint projects with other Federal agencies and private institutions.

One of the most striking examples may be the major, comprehensive, field investigation in support of the world weather program, presently planned for 1969. It will be executed within the general area of Barbados, with primary focus on the problem of ocean-atmosphere interaction, as well as related physical oceanography and small- and medium-scale meteorology. Planning for this field experiment has been carried out with other agencies such as the Navy, Department of Interior, Department of Health, Education, and Welfare, NASA, and the National Science Foundation, and the Department of Transportation. It will involve extensive university participation and possibly that of other nations.

I am pleased to report that the global expedition of the *Oceanographer*, another example of interagency and international cooperation, has been extraordinarily successful. The *Oceanographer*, commissioned by President Johnson on July 13, 1966, today is working in the Tasman Sea, between Sydney, Australia and Wellington, New Zealand. By the time she reaches her home port, Seattle, Wash., she will have had on board as participants or observers, some 50 foreign scientists from 16 countries, 11 scientists from other Federal agencies, and 11 scientists from seven U.S. universities. This ship, and its sister ship, the *Discoverer*, are the newest of this Nation's seagoing research vessels. Both have the most modern equipment for studying the marine environment. The *Oceanographer's* research results have been significant. They include:

1. A new submarine canyon has been discovered, mapped, and sampled in the Andaman Sea.
2. Upwelling of deep water off the west coast of India has been related to the onset of the monsoon.
3. A new deep pool of hot water in the Red Sea has been discovered and sampled.
4. A new fracture zone in the Atlantic, postulated on the basis of earthquake epicenters has been discovered and mapped.

In Alaska, ESSA and the Geological Survey have joined to map areas necessary to obtaining an inventory of heavy metals on the northern Bering Sea Continental Shelf. We are also cooperating in studying lava flows on the submerged slopes of Pacific islands. Cooperative mapping is undertaken in conjunction with the Bureau of Commercial Fisheries. One of the major instances of interagency cooperation is the joint program of ESSA and the Navy known as Project Stormfury, which seeks to understand the processes that may lead to the modification of hurricanes at sea.

The Houston, Tex., Spaceflight Meteorology Group of the Weather Bureau provides NASA with meteorological and sea-State information in support of NASA's manned spaceflight programs.

As our new hydrographic and oceanographic fleet comes into operation, and with the aid of aircraft, buoys, satellites, and other platforms, we expect to conduct many more multipurpose, multiagency investigations, all directed toward the acquisition of information on the oceans. We have established an Advisory Board for Ship Time Allocation to evaluate proposals from other agencies and from universities which desire to avail themselves of the capabilities of our ships for their specific marine investigations.

PLANS

I have sketched in broad scale our basic service programs in the marine environment and the manner in which they are essential to any comprehensive national program to develop marine resources and use the seas in many other ways. They are extensive, they are vital to the Nation, they are functioning well within the range of present knowledge and available resources. They are by no means perfect and by no means complete. I should like to tell you now of plans to improve them.

Mankind looks to the oceans for new resources and food for the future, as a medium of transportation and recreation, and as a key to our ability to predict the weather more accurately. This will require new, or improved, or expanded marine environmental services. Our observational information about the oceans today is meager. This critical deficiency must be eliminated. We must understand more fully the interactions between atmosphere and ocean, and the ocean and the earth so that better prediction techniques for both sea and air may be developed. We need faster dissemination of warnings and forecasts to mariners on the high seas, on the Continental Shelf and to coastal dwellers. We need more accurate and more extensive maps and charts of the ocean bottom and its characteristics. We hope to improve our ocean and weather prediction by obtaining more coastal and ship reports, by using new observing devices such as satellites and buoys. We expect gradually to begin to issue routine seaState and sea surface temperature forecasts prepared by our National Meteorological Center. We are planning an estuarine flushing prediction service to combat pollution and enhance seashore use. Marine forecast centers are planned for San Francisco and Washington—to be manned by meteorologists trained in physical oceanography. I have already spoken of the establishment of continuous VHF–FM marine weather transmitters, which will serve 8 million boatsmen. Facsimile and marine radiotelephone broadcasts will help insure timely delivery of our predictions and warnings.

In the area of mapping and charting, we have commenced a program to make maximum use of our existing data to provide topographic maps of the sea floor. An important start has been made with issuance of such charts for the Aleutian Island area and California coastal waters. We need contour maps of coastal areas susceptible to flooding from storm surge. An improved and automated data collection and processing system for mapping and charting is under development.

ESSA also plans a project on mean low-water mapping for establishment of coastal baselines along the outer coasts of the United States and its possessions. Baselines mapping is needed for the establishment of accurate boundaries seaward, which are of prime importance to the development of Continental Shelf resources.

However, the limitations which bind us cannot be removed fully unless our understanding of the global ocean is improved far beyond its present state.

RESEARCH

The key to this improvement lies in research.

The execution of our research program involves several separate but related requirements:

To measure and understand large- and small-scale physical and dynamic processes in the ocean, atmosphere, and solid earth.

To measure and understand the boundary process of the ocean-atmosphere interface and to build a physical theory of its fluctuations.

To measure and understand the ocean floors, continental margins, crust and mantle of the ocean basins, and interactions between solid and fluid media.

The answers to these problems will give us more effective weapons against the hurricane; assist in modeling the ocean-atmosphere system toward better understanding of drought and other large-scale phenomena; tell us more about the genesis and propagation of tsunamis; assist in development of satellite instrumentation for global observation of environmental parameters from space and near-space; and aid in development of advanced sensing and telemetering techniques—all vital, practical items toward the advancement of our uses of the sea.

The full or partial solution of the several elements of the research problem will lead to the development of applied techniques for one of our highest priority activities, the development of a global environmental prediction system. To this end, we must consider not only oceanic parameters but the physical interactions with earth and air.

I have already mentioned the plans for an extensive field program for the study of the interactions between ocean and atmosphere. It will involve the use of many ships, buoys, aircraft to acquire the measurements of the manner in which energy is transferred between the two physical systems and represents the focal problem that must be solved if we are to better predict ocean and weather conditions.

ESSA has also been developing numerical models of the earth's atmosphere and oceans. A six-level ocean circulation model now can incorporate the effects of temperature and wind variations. The utility of such models in predicting feedback effects on hurricane formation and storm developments and modification are exciting to contemplate.

Another theoretical study with direct practical application is concerned with the storm surge phenomenon. This destructive and abnormal rise of water at a coastline is induced by storms at sea and influenced by the normal tidal motions and the bottom topography. From these studies it has been possible to develop nomograms that give a preliminary objective forecast.

Research on tides is a major part of our mission. ESSA researchers have developed a new method for predicting tides in shallow water, resulting in markedly improved predictions in widely dispersed locations.

ESSA's open ocean tide program is planned to comprise the principal part of our Nation's contribution to the international deep sea tide program. It is a departure from tradition. In the past, tidal measurements have been restricted to coastlines and islands. Now, with advances in instrumentation, platforms, and data processing, open ocean measurements are feasible.

The marine environment is not limited to the ocean. The Great Lakes also are included. In that region, wind-generated waves present a problem in the safety and economy of shipping operations, and our research is directed to a solution of this problem, also.

This is a brief description of ESSA's present and planned efforts in support of the Federal program in marine sciences—a field of tremendous importance to people of our Nation.

Before I finish, I would like to change hats for a moment to take this opportunity to inform this committee of progress which has been made by the newly formed Marine Council Committee on Ocean Exploration and Environmental Service, which the Vice President has asked me to chair. This is a new Committee, one of five recently established to bring together coordinated Federal efforts directed at meeting priority national requirements in marine science. The Committee is so recently formed—August 16, 1967—that it is not possible for me to report on our progress except to say we have met twice and have begun to assess the magnitude and complexity of our problems.

The Committee is responsible for policy and program recommendations regarding exploration, description, and prediction, and the required ships, buoys, satellites, and other facilities. It is also responsible for surveys, mapping, and charting of the Continental Shelf and deep oceans, data management and the coordination of technical aspects of surveys for ocean bottom resources.

The Committee's major work lies ahead. I should like to assure the subcommittee, however, that in the execution of this work our interagency group will labor constantly to formulate programs which take full advantage of the capabilities of all Federal agencies and meet our national needs.

I shall be very happy to try to answer any questions.

Mr. ROGERS. Thank you very much, Dr. White, for an excellent statement.

Mr. Pelly?

Mr. PELLY. Dr. White, we had testimony recently from a Department of Interior witness that indicated the Department of Interior is mapping the seabed as far out as a hundred miles. Do you work in cooperation with them?

I notice on page 6 of your statement you refer to the bathymetric map and underwater topography. Do you do their mapping for them or would you indicate what cooperation there is between the Departments?

Dr. WHITE. Yes. We work very closely with Geological Survey. As I have indicated in my testimony, we have a program of assisting them in the mapping, for example, of the regions off Alaska.

In addition to this general kind of mapping which is required for mineral exploration, there will also be required rather detailed surveys when you actually come down to very specific items that have to be done. And the Geological Survey has been doing some of these very surveys.

In addition to that, the Geological Survey has also put out a number of large-scale topographic maps. These are different from those which we are putting out in that they cover a very broad area and the density of the information is very low. The data on which these are based are the data from the Coast and Geodetic Survey. The reason for doing it is because they had to get on immediately with the problem, and they process these data on a very large scale to start with.

Mr. PELLY. I am hopeful you will proceed rapidly and expeditiously to map out our coastal water seabed before it is transferred under international law to the United Nations as is now being proposed. I hope we can expedite this work. I am glad to hear of this departmental cooperation.

In your reference to Project Storm Fury, is there any restriction that you find on your work in modifying hurricanes because you are prevented by international law from the use of atomic explosions in the atmosphere?

Dr. WHITE. We have never contemplated using atomic explosions in our hurricane modification work. We use a rather special kind of silver iodide seeding technique not restricted by international law.

We do, of course, consult with the various nations in the areas in which we are going to operate.

Mr. PELLY. The program, then, would indicate the importance of this research?

Dr. WHITE. Yes; we feel this is a very vital research.

Mr. PELLY. I have one or two other questions that came as I listened to your testimony. One has to do with my own interest in the Pacific Northwest.

You referred to the 19 VHF–FM marine weather broadcast stations. I understand you have scheduled one for the State of Washington. Perhaps you could tell me when we might expect to get it.

Dr. WHITE. I can give you that for the record, Mr. Congressman. I do not have the details with me.

Mr. PELLY. All right.

(The information follows:)

The FY 1968 Congressional budget contains funds for the installation of a VHF–FM station at Seattle.

Mr. PELLY. On page 14 of your statement, you refer to international arrangements on meteorological work. Do we now exchange weather information with the Soviet Union?

Dr. WHITE. Yes, we do; sir. We have excellent cooperation with the Soviet Union on the exchange of weather data.

Mr. PELLY. Is it very helpful and quite important?

Dr. WHITE. Yes. International cooperation in the exchange of weather data has a long tradition. Every nation needs the weather data of every other nation. We could not predict the weather in the United States if we did not have the weather data from the Soviet Union and the Soviet Union could not predict their weather if they did not have our weather information.

Mr. PELLY. This would be important to Midwest farmers, would it not?

Dr. WHITE. Yes.

Mr. PELLY. When storms are coming they could save their cattle if we had information as to the weather conditions over Siberia, for example?

Dr. WHITE. Yes, it is very vital to any forecast, let's say roughly over 1 day in length.

Mr. PELLY. I could not help but think of this tremendous program for the future which you have outlined, and selfishly wonder why we have the *Oceanographer* down in waters far away from our own country since we have so much to do in the way of developing our own Continental Shelf and our own coastal waters. Why we are putting forth such a tremendous amount of our equipment and scientific effort down off Tasmania?

Dr. WHITE. At present that is where the ship is working, sir. The *Oceanographer* is on its way to Seattle, which will be its home base.

Mr. PELLY. I am all for that, I want you to understand.

Dr. WHITE. Its principal area of operation will be in the Pacific; it will be doing the surveys on the shelf and in the deep oceans in that area.

Another purpose of our oceanographic efforts of course is to encourage international cooperation. This is obviously an activity which is going to require the participation of many nations and represents a very excellent way in which we can build bridges between nations.

In the commissioning of the *Oceanographer* by the President, he indicated that he was very much interested in building up this kind of international cooperation. This is one of the purposes of the expendition.

Mr. Pelly. I can see that is very important, but I think you will agree that we have an awful lot of work to be done right here close in our own waters. It would seem to indicate that we have to stretch ourselves pretty thin in order to participate in international affairs. It leaves us rather inadequately staffed and equipped to take care of all we have ahead of us in your program.

Dr. White. Yes, sir. It is clear that one must be very judicious in the deployment of the resources we have. Our problems in our own waters are overwhelmingly large. On the other hand, the oceans are global in nature. In order to understand the current systems that flow along the Pacific Coast, it is necessary to understand the current systems of the entire Pacific Basin because they are interlinked. It is very meaningful for us to do things far from our shores.

Mr. Pelly. I was particularly gratified to know you are not neglecting Alaska. I say that for the benefit of my colleague here. I did find out you are doing work on the Continental Shelf there. I think that is very important.

Dr. White. Thank you, Mr. Chairman.

Mr. Rogers. Mr. Pollock.

Mr. Pollock. Mr. Chairman, thank you.

Dr. White, I have several comments. First, I would like to say I was at the Palmer, Alaska, dedication of the new Tsunami warning system there and very delighted to see that. I think the vital center is in Honolulu.

Dr. White. The major center is at Honolulu.

Mr. Pollock. I wanted to follow up on two matters my good colleague from Washington talked about, the VFH–FM marine weather broadcasting stations and the 6-hour general area forecasts to support commercial fishing. I am wondering why all of them seem to be on the east coast and the Gulf of Mexico and none on the Pacific side and at San Juan.

Dr. White. Our future plans call for the establishment of such marine centers on the Pacific Coast and Alaska.

Mr. Pollock. Could you provide for the record the schedule of your programing?

Dr. White. I can do that, sir.

(The information follows:)

The FY 1968 Congressional budget contains funds for staffing a Marine Forecast Center at San Francisco. Services would include weather and wind wave information for commercial fishing. Present plans are to establish a Marine Forecast Center at Anchorage in 1969 if funds are available which would provide services in support of commercial fishing, including wind wave information. In succeeding years, VHF–FM stations are planned for Juneau, Yakutat, Anchorage, Cordova, Kodiak, King Salmon, Ketchikan, Sitka, and Seward.

Mr. Pollock. Perhaps the members of the committee already know, Mr. Chairman, but I wonder, Dr. White, if you could tell me what the Inter-Governmental Oceanographic Commission is and how it functions?

Dr. White. The Inter-Governmental Oceanographic Commission is a body of UNESCO, of the United Nations. It is that body which has been designated internationally to provide for international coordination of and collaboration in scientific investigations into the oceans and the scientific aspects of resources.

Mr. Pollock. Are there any member nations of the U.N. that are not participating?

Dr. White. Yes; there are about 55 members of the U.N. family of nations who are presently members of the Commission. So a sizable number are not participating.

Mr. Pollock. Getting back to Alaska for a minute, on page 16 you talked about the collaboration with the Geological Survey to map areas necessary to obtain an inventory of heavy metals on the Bering Sea Continental Shelf. When did that start?

Dr. White. With your permission, I would like to ask Admiral Jones to answer that question.

Admiral Jones. The heavy metals program will be starting next year. We are putting about five and a half months of ship time into a cooperative effort with the Department of Interior.

We will run bathometric and other geophysical surveys, first at a reconnaissance spacing, and then develop interesting areas that the Geological Survey selects. This will provide them with the detailed topography, corings of the ocean bottom, and other data needed by the heavy metals program.

Mr. Pollock. Can you tell me how you can determine in this program your search for heavy metals as distinct from any others?

Admiral Jones. The geophysical characteristics: gravitational determinations and magnetic surveys assist the geologist in determining the gravity and magnetic anomalies in the area; this along with corings in the ocean bottom provide samples of material for study.

All of these data are used to prepare graphic displays for analysis and detailed study by geologists, providing them with basic geophysical information for determination of heavy metals characteristics of the area.

Mr. Pollock. The Continental Shelf in that area actually extends continuously between Alaska and over to Siberia.

I don't think there is any area that is not part of the Continental Shelf there.

Admiral Jones. That is correct, except for the Aleutian basin in the southern Bering Sea.

Mr. Pollock. So would you be going to the 180th meridian, or what is our international dateline?

Admiral Jones. Our boundary within the area is not on the dateline exactly (U.S.-Russian Convention 1867). It extends west of the 180th meridian, in the lower portion of the Bering Sea.

Mr. Pollock. The international dateline in that part of the country is not the 180th meridian.

Admiral Jones. No, it is not the 180th meridian. The Geological Survey has blocked off a considerable area extending from Norton Sound.

This is their specific interest. The Alaska Bering Sea Continental Shelf area is tremendous, a large percentage of our total Continental Shelf area. It will be many, many years before we can completely describe that area with adequate hydrographic surveys with the resources and ships that we have available.

Mr. POLLOCK. Mr. Chairman, I apologize for being so parochial but this is an area that is of vital interest to all of the United States. It is a vast area with tremendous potential. I have no further questions.

Mr. ROGERS. Dr. White, what is the extent of the Continental Shelf on the east coast and west coast in terms of distance, generally speaking?

Dr. WHITE. Could you comment, Admiral?

Admiral JONES. On the east coast the Continental Shelf averages about 100 miles in width. On the west coast the shelf is much narrower, averaging 30 to 40 miles except the vast shelf areas between Alaska and Siberia.

Mr. ROGERS. And what depth?

Admiral JONES. As the Continental Shelf descends slowly seaward, there is an abrupt change in the bottom slope marking the transition from Continental Shelf to continental slope. This transition area is called the shelf break. It occurs at a depth of 165 feet off the southern tip of Florida, but is found at a depth of 395 feet off New England.

Mr. ROGERS. What would be the greatest depth?

Admiral JONES. Of the Continental Shelf?

Mr. ROGERS. Yes, on the west coast.

Admiral JONES. Conventionally the Continental Shelf is referred to that area within the 200 meter or 100 fathom depth curve. The depth of the shelf break on the west coast varies considerably. At Santa Barbara it is about 100 meters—330 feet. At other locations it is much deeper. The world average is generally accepted as about 200 meters.

Mr. ROGERS. Is this still the definition of the Continental Shelf, the 200-meter depth?

Admiral JONES. Yes. Outside of that general depth the continental slope normally goes off at a much steeper rate into the deeper areas of the ocean.

Mr. ROGERS. Roughly, how much of the Continental Shelf is mapped now?

Admiral JONES. I would say probably 80 percent of our Continental Shelf has been covered by hydrographic surveys for nautical charting. These surveys provide the information for bathymetric mapping of the Continental Shelves; however, many of these surveys are considered inadequate for bathymetric mapping because they were completed before the advent of echo sounders and electronic position-finding equipment.

Mr. ROGERS. Are we in the process now of doing a mapping job on the east coast of the Continental Shelf?

Admiral JONES. Yes; we are in the process of upgrading surveys, many of them completed in the 1880's. We are trying to upgrade these.

Mr. ROGERS. What cooperation do you get from the oil companies? I presume the oil companies have done a great deal of mapping.

Admiral JONES. Most of their hydrographic operations are in greater detail than is needed for nautical charting and they do intensive geophysical operations as well.

Mr. ROGERS. Is there any interchange of information between the oil companies and you?

Admiral JONES. Yes, there is. Many times the oil companies have requested and we have furnished copies of the hydrographic surveys we have made for nautical charting.

Mr. ROGERS. Do you get good cooperation from the oil companies?

Admiral JONES. Yes; we do.

Mr. ROGERS. Are there any that do not cooperate?

Admiral JONES. No; I do not believe I can say that. However, the oil companies obtain geophysical measurements, gravity anomalies, et cetera, and do not always wish to furnish this information.

Mr. ROGERS. Because it would reveal their trade secret.

Admiral JONES. Yes.

Mr. ROGERS. Is there any work going on which would be helpful to the Corps of Engineers on wave action concerning the problem of erosion? Do you have any work going on in this area?

Dr. WHITE. Our forecasts of storm surges, tides, and coastal currents are very important in supporting their work.

Mr. ROGERS. But no research as such?

Dr. WHITE. We have a small activity at Norfolk which deals with some aspects of the interaction between the ocean and the land, the problems of sedimentation, and ultimately for giving us information on the rates of changes of the topography for mapping purposes.

Mr. ROGERS. In the survey of heavy metals, do you use any submersibles, or is it done from surface ships?

Admiral JONES. No, sir; we have no submersible capability.

Mr. ROGERS. None at all?

Admiral JONES. None at all.

Mr. ROGERS. Are there any efforts to get any?

Dr. WHITE. If I might answer that, we think that there are activities we would like to undertake where they would be valuable. Of course, whether we obtain submersibles will have to be a judgment in any particular budgetary situation as to whether that is more important than other activities we are dealing with.

Mr. ROGERS. Is the Department planning to request this activity?

Dr. WHITE. There have been discussions in the Department. There is no formal request for submersibles.

Mr. ROGERS. Would you let us know your feeling on that for the record?

Dr. WHITE. Yes.

Mr. ROGERS. And the use of these submersibles?

(The information follows:)

Sufficient research and/or development requirements presently exist to justify the use of submersibles. Areas of interest include detailed mapping of bottom topography, studies of mixing processes, investigations of hazards to navigation, support of underwater instrumentation activities and others. ESSA could beneficially make use of submersibles to further its mission.

Mr. ROGERS. I think one of the areas that the Russians are now very active in is an attempt at weather control. The new Director of the Oceanology Institute in Moscow has a background in this area. I wonder what work we are doing in weather control, or are we doing any research in this area?

Dr. WHITE. You are correct when you say the Soviet Union has a very active program in weather modification. They are looking at various aspects of weather modification, including rainfall augmentation, hail suppression, snow redistribution. We also in this country have a rather extensive program in weather modification research looking at these kinds of things and other ones, also. We can provide for the record information on the nature of the work.

Mr. ROGERS. I think that would be helpful.

(The information follows:)

WEATHER MODIFICATION RESEARCH

ESSA's program in weather and climate modification covers a rather wide spectrum of activities. In general it is aimed at realizing the full potential of the many different forms of weather modification ranging from altering precipitation characteristics to the possible moderation of tropical hurricanes and severe thunderstorms and tornadoes. Other major areas of interest are the mitigation of hail and lightning storms, and the possibilities for modifying regional and large-scale climates.

Research into weather modifications necessarily involves large-scale field projects to explore storm systems and cloud conditions, as well as to carry out carefully designed experiments in cloud seeding and other means for atmospheric modification. An example is Project Stormfury, carried out jointly with the United States Navy, with assistance from the Air Force, to explore the possibility of moderating hurricanes. Another is our Great Lakes Project in which we are investigating means for reducing or redistributing the excessive snowfalls which occur in early winter due to the effect of the lakes on the weather in that area. Plans have been laid for projects in the Northeast and in the Southeast to fully explore the potential for modifying precipitation, including increases, reduction (for example, to reduce flood hazards), and redistribution, when economically desirable.

In addition to Project Stormfury extensive aircraft reconnaissance into hurricanes each year is carried out by our Research Flight Facility, and results are analyzed by our National Hurricane Research Laboratory at Miami. Similarly, intensive studies of severe local storms and tornadoes are made each spring at the National Severe Storms Laboratory at Norman, Oklahoma, where we are joined by any other Federal agencies and other research groups.

Although deliberate modification of large-scale climatic conditions seems way beyond our reach at present, the possibility does exist that through air pollution we may be already producing some effects, and we are taking steps to measure such pollution and to evaluate the probable effects. For example, concern is being expressed over the possible increase in atmospheric carbon dioxide through the burning of coal and oil, which might raise the earth's temperature and produce undesired effects. Our observatory on Mauna Loa, Hawaii, has been established as a benchmark for the monitoring of pollution in "clean" air. We plan similar stations along the West Coast of the Americas and from Alaska to the South Pole, to assist in this effort.

There are many facets to weather modification and to our research program. I would like to emphasize one important aspect, and that is the growing use of high-speed computers. These are permitting the simulation or "modeling," as we say, of weather processes more and more realistically. We now use computers extensively in forecasting, and their use in weather modification studies will make it increasingly possible to carry out modification experiments in the laboratory. This will permit refinement of experimental techniques before field testing is begun, and will also materially aid in the analysis of actual experiments. Such preliminary testing of experiments designed to modify climates would of course be an absolute "must" before any actual trials were attempted.

Mr. ROGERS. Do you feel we are making progress in this area?

Dr. WHITE. I think we are, yes.

Mr. ROGERS. I was interested in noting the findings that the *Oceanographer* had already developed. I think the present voyage is an excellent one. As you pointed out, even though we have a lot of work to do around our own coast, whatever happens in the oceans in many areas is of vital interest to us and to our merchant ships. What is the significance of this new deep pool of hot water in the Red Sea, for instance? Is it of great significance?

Dr. White. Some people think it is of very great significance, Mr. Chairman. This is not a new discovery of this ship. Other such pools of brines with heavy concentrations of elements which some people believe could be very readily exploited have been found by other expeditions. The *Oceanographer* has found a new one that other people have not found. They have been found before in this area.

Mr. Rogers. What is the natural disaster warning system that you speak of?

Dr. White. The natural disaster warning system, Mr. Chairman, is a plan which we have prepared which seeks to bring the best of our present technology to bear—in order to provide accurate and timely warnings of natural disasters of all kinds on a nationwide basis. We have concluded as a result of a number of disasters in the past few years that there are deficiencies in the present system. For example, we are deficient in providing emergency power, rapid dissemination of warnings in some areas, and in providing adequate radar coverage.

There is a major task to be done in community education, and community preparedness plans. As a result of the analysis of a number of these disasters including the Palm Sunday tornadoes of several years ago, this plan was devised so we could bring our warning services to the highest level we could, given the existing techonology.

Mr. Rogers. This is to be interagency?

Dr. White. This plan was prepared by an interagency group. The main burden of it will fall on our organization.

Mr. Rogers. Will you give us a detailed explanation of these agencies for the record?

Dr. White. Yes, sir.

(The information follows:)

Makeup of NADWARN

The nationwide Natural Disaster Warning (NADWARN) System planning group was comprised of representatives of ESSA, Coast Guard, Army Corps of Engineers, Federal Communications Commission, Office of Civil Defense, and Office of Emergency Planning. Many agencies and organizations, federal, state, county, city and private, are involved in disseminating the warnings to the public.

Mr. Rogers. I have one last question. Have you tried any control measures on the hurricanes that we have had this year? Have you done any seeding or attempted to try to divert the hurricanes?

Dr. White. None of the hurricanes this season, so far, have come within the area that we are operating in. Our aircraft have been in readiness and we are all set to go. We are just waiting for a hurricane. We had hurricanes like Beulah and Doria but neither were in appropriate situations.

Mr. Rogers. You are only doing research in a certain area because you do not want a storm to be too close to land because you do not know for sure what the reaction would be from the seeding. What is the significance of not doing it on these areas?

Dr. White. We wish to conduct our research over the open oceans where the effects of the land are minimized. When a hurricane comes near land its characteristics are very significantly changed. That means if we were to carry out our activities near land it would be very difficult for us to tell whether what we did was really the cause of what happened or not. So we want to do it over the open ocean.

Mr. Rogers. Will you let us know for the record what area you are operating in, what equipment you have to operate, and how many people are involved? What is your total budget, in round figures?

Dr. White. The total budget for the organization, and this is based upon the House allowance this year because we have not gone completely through our Senate process yet, I think is $165 million, sir. I can give you the exact number for the record.

(The information requested follows:)

The former prescribed operating area—which limited hurricane seeding to a strip of the southwestern Atlantic between Puerto Rico and Bermuda—has been enlarged and modified. Instead, Project officials will rely on official Weather Bureau forecasts of hurricane tracks and positions in selecting storms in the southwestern North Atlantic for experimentation. Under the new criteria, a hurricane in the southwestern North Atlantic will be considered eligible for seeding as long as there is a small probability (10% or less) of the hurricane center coming within 50 miles of a populated land area within the ensuing 24 hours.

The change in criteria should permit seeding exepriments to be conducted in a greater number of storms. During the 1965 and 1966 hurricane seasons, no storms suitable for seeding moved through the geographical area then prescribed for the experiment. Under the new criteria, two storms would have been eligible each of these two years.

Aircraft involved in Project Stormfury include four specially instrumented lanes of ESSA's Research Flight Facilitity (RFF). The two DC–6's, one C–54, and one WB–57 all based at Miami, Florida, monitor the experiments by recording numerous meteorological observations from 1,500 feet to 40,000 feet. Approximately 100 ESSA employees are involved in hurricane research, some 10 of these are concerned primarily with the modification of hurricanes.

In addition to the ESSA aircraft, the Navy provides ten planes for the actual seeding operations.

DEPARTMENT OF COMMERCE, ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION, FISCAL YEAR 1968 APPROPRIATIONS REQUEST—TOTAL ESSA BUDGET VERSUS MARINE ENVIRONMENT PORTION

[In thousands of dollars]

Budget activity	All ESSA appropriations			Marine environment distribution		
	Requested	House allowance	Senate report	Requested	House allowance	Senate report
Weather forecast and warning services	89,214	82,350	87,440	1,220	508	2,173
River and flood prediction and warning services	4,172	3,774	4,060	--------	--------	--------
Earth description, mapping, and charting	14,480	12,729	13,568	896	596	773
Hydrographic and oceanographic services	24,603	20,482	22,690	24,603	20,482	22,690
Telecommunications and space services	7,605	6,540	6,936	--------	--------	--------
Envoronmental data services	5,345	4,750	5,108	297	259	305
Environmental satellite (R. & D.)	2,825	2,390	2,566	100	--------	--------
Satellite operations	32,200	28,100	28,100	--------	--------	--------
Engineering support	1,019	922	922	439	221	221
Retired pay, commissioned officers	1,013	1,013	1,013	--------	--------	--------
ESSA total	182,476	163,050	172,403	27,555	22,066	26,162

Mr. Rogers. I notice in the Council report, in the breakdown on oceanography, they have the Department of Commerce listed for $36 million for fiscal 1968. Does this include salaries?

Dr. White. That was our request to the Congress, Mr. Chairman. It includes $8.5 million for the Maritime Administration effort in transportation and $27.5 million for ESSA's effort in the multigoal activities detailed under item 10, page 107 of the report.

Mr. ROGERS. You requested only $36 million and the Congress is giving you more than $130 million? Was that last year?

Dr. WHITE. I'm sorry, sir. ESSA's portion of the $36 million relates to our 1968 appropriation request of $182 million covering all of our activities, only part of which deal with the marine environment. The House has reduced our request to $163 million which, in turn, reduced our marine environment program from $27.5 to $22.1 million. Our appeal for restoration of $9.3 million of which $4.1 million is related to marine environment activities has been reported out favorably by the Senate.

Mr. ROGERS. The other would be weather?

Dr. WHITE. Weather, seismology, a variety of things.

Mr. ROGERS. Will you give us a breakdown for the record?

Dr. WHITE. We can do that, sir.

Mr. LENNON. Mr. Keith, do you have any questions?

Mr. KEITH. Thank you, Mr. Chairman.

Dr. White, in addition to yourself, several other witnesses have discussed the efforts of various agencies in mapping and charting various segments of the oceans. Although a great deal of this work is done on a cooperative basis, I am concerned about the lack of overall coordination of our efforts in mapping and charting ocean areas. Without such coordination, it seems to me that we might end up with great duplication on the one hand, and yet some vital areas might be left completely untouched. I hope you can assure us that such coordination is now taking place and can tell us how this coordination is being accomplished. If not, I would appreciate your comments on the advisability of such coordination and the means best suited to achieve it.

Dr. WHITE. There are only two U.S. agencies with the statutory authority for conducting nautical chart surveys in U.S. coastal and deep ocean areas: the Coast and Geodetic Survey of ESSA, and the U.S. Navy. The Coast and Geodetic Survey conducts surveys in coastal areas of the United States, its territories and its possessions, to provide adequate nautical charts of these areas. The U.S. Navy conducts surveys in areas outside of the Coast and Geodetic Survey's statutory responsibility to provide adequate nautical charts for its own oceanwide operations. Coverage in overlap areas is accomplished through mutual exchange of survey data. The Navy uses Coast and Geodetic Survey survey data whenever possible in compiling special-purpose charts in U.S. coastal waters. This exchange of data is handled informally and the procedure appears to be quite effective. The Corps of Engineers, U.S. Army, now produces a set of nautical charts for the gulf coast intra-coastal waterway. These charts were compiled from Coast and Geodetic Survey survey data and from Corps of Engineers channel dredging data. In any event, the Corps of Engineers plans to discontinue this series when the Coast and Geodetic Survey has completed coverage of the same area with its small-craft chart series.

The U.S. Navy and the Coast and Geodetic Survey have the statutory authority to conduct bathymetric and geophysical mapping surveys, with no specific geographic limitation. The Coast and Geodetic

Survey has interest in mapping the Continental Shelves and certain deep ocean areas as well. The Navy has its own requirement for certain types of bathymetric and geophysical maps of shelf and deep ocean areas. In producing its special bathymetric maps for submarine navigation on the U.S. Continental Shelves, the Navy obtains and uses Coast and Geodetic Survey survey data. The Coast and Geodetic Survey will soon conduct bathymetric and geophysical mapping surveys in the northern Bering Sea in cooperation with the U.S. Geological Survey, as part of U.S. Geological Survey's program for taking inventory of Bering Sea heavy metals resources.

To produce its 1:1,000,000 scale bathymetric map series of the east coast for the U.S. Geological Survey, the Woods Hole Oceanographic Institution utilized Coast and Geodetic Survey survey data almost exclusively for delineation of U.S. Continental Shelf waters. There are a number of cases where special-purpose Continental Shelf bathymetric maps are constructed by other agencies using Coast and Geodetic Survey hydrographic survey data. There are no known cases where other agencies have accomplished field surveys to obtain this data.

Only the Coast and Geodetic Survey has responded to date in accomplishing any part of the National Academy of Science Committee on Oceanography's recommended program for mapping the world's oceans (now called SEAMAP). The Navy, in order to produce special-purpose maps of the oceans for antisubmarine warfare and similar military purposes, is now contracting for surveys in part of the SEAMAP area already covered by Coast and Geodetic Survey work. Prior to beginning the contract work, the Navy asked for, and received, copies of Coast and Geodetic Survey data.

There is a long history of direct coordination, between the Navy and the Coast and Geodetic Survey, in the areas of charting surveys and marine data utilization. There is now direct coordination between the U.S. Geological Survey and the Coast and Geodetic Survey in determining the degree to which Coast and Geodetic Survey can satisfy the U.S. Geological Survey's needs for old survey data and for new surveys. The Survey Panel of the Interagency Committee on Oceanography (ICO) was used as a mechanism for coordinating survey activities between agencies. This group was fairly effective in eliminating duplication of effort. The Marine Resources and Engineering Development Council has now established a formal mechanism for coordination of surveying and mapping activities in its Committee on Oceano Exploration and Environmental Services of the Marine Resources and Engineering Development Council.

Mr. Keith. You mentioned an Advisory Board for Ship Time Allocation, within ESSA, which evaluates requests from other agencies and from universities interested in availing themselves of the capabilities of ESSA's ships for their specific marine investigations. It seems to me that such a board is a very good idea on a theoretical level. How has it worked out so far?

Do you feel that it would be advantageous to establish a multiagency board, on which all agencies that operate research vessels would be represented, to perform a similar function involving all research vessels operated by the various agencies?

Dr. WHITE. To date, 50 scientific oceanographic proposals have been reviewed by the Advisory Board on Allocation of Oceanographic Ship Facilities of ESSA from other agencies or institutions. Twenty-seven of these proposals have not been recommended for ESSA involvement. Of the 23 proposals recommended by the Board, the Coast and Geodetic Survey has, or is in the process of, cooperating in 16 to varying degrees, with a minimum of ship time interference. The remaining recommended proposals cannot be implemented without seriously sacrificing ongoing programs at this time.

A multiagency board on which all agencies that operate research vessels would be represented, to perform a similar function to that of ESSA, involving all research vessels operated by various agencies, could be advantageous to the national effort. A study would have to be made whether such a board would be more effective than individual agency boards.

Mr. KEITH. As you may know, I have introduced legislation that looks to the creation of marine sanctuaries. I would appreciate it if you, as the spokesman for ESSA, would tell me what your position is on the advisability of establishing such sanctuaries as are contemplated in the bill I introduced.

Assuming that such a program is established, what role should ESSA play in assisting in the determination of areas which should be established as sanctuaries?

Dr. WHITE. The Department of Commerce has received a request from the Committee on Merchant Marine and Fisheries for a report on H.R. 11548, a bill to authorize the Secretary of the Interior to study the most feasible and desirable means of establishing certain portions of the tidelands, Outer Continental Shelf, seaward areas, and Great Lakes of the United States as marine sanctuaries and for other purposes.

The Department of Commerce is expediting its preparation of this report, and as soon as coordination with the Bureau of the Budget is completed, the report will be forwarded to the House's Merchant Marine and Fisheries Committee.

Mr. KEITH. That is all Mr. Chairman.

Mr. LENNON. Doctor, for the record you are one of the 15 members on the Commission appointed by the President; is that correct?

Dr. WHITE. Yes, sir.

Mr. LENNON. You are the opposite to the Secretary of Commerce under the National Council.

Dr. WHITE. No, I am not, sir. The Assistant Secretary is the alternate.

Mr. LENNON. Was it under the authority of the National Council that you were designated by the Vice President to serve on the newly formed Committee on Ocean Exploration and Environmental Science?

Dr. WHITE. Yes, sir.

Mr. LENNON. Because under the act the Council headed by the Vice President, designates the Chairman to authorize any agency of the Federal Government to assist them in their overall study of the total marine development program. Has ESSA been involved in the preparation of the maps that are now being used by the Department of Interior for the leasing of the Continental Shelf?

Admiral Jones. Sir, I do not believe that we have been involved in the preparation of these maps. However, we have cooperated with the Department of Interior by furnishing special low-water line maps along the Louisiana coast and by extending geodetic control out into the Gulf of Mexico. This control data is made available for the construction of the maps and for defining the lease property lines.

Mr. Lennon. You are familiar with the fact that the Department of Interior now, and for the past 18 months, using these maps of the Continental Shelf, have been actually making leases with private enterprise for the exploration and exploiting of certain areas of the Continental Shelf under specific lease agreements?

Admiral Jones. Yes, sir.

Mr. Lennon. I believe last year the income to the Federal Government from some seven leases was about $238 million. Do you have any figures such as that on the top of your head?

Admiral Jones. I have seen some of the figures from the leasing, and I do know it is a tremendous amount of money that the Government is realizing.

Mr. Lennon. Can you recall off the top of your head the figure in dollars that came to the Federal Government through the leases that were made by the Department of Interior during the month of July of this year?

Admiral Jones. No, sir.

Mr. Lennon. The figures were released yesterday and they were astronomical. Just for the record, Doctor, and Admiral, would you tell us under what act the Department of the Interior has the legal authority to lease a part of the Continental Shelf to private enterprise for exploration and exploiting?

Dr. White. We will be glad to obtain that from the Department of Interior, Mr. Chairman.

(The information follows:)

The Mineral Leasing Act of 1953, 67 Stat. 462 Public Law 212 of the 83rd Congress, First Session, passed August 7, 1953.

Mr. Lennon. This question has arisen in connection with the so-called Malta Resolution. It gave me some concern—I will say to my friends of the press that we are off the record at this point but on the record here—I am advised that very likely our Ambassador will give an assurance to the members of the General Assembly that it is not in the general public international interest to make such leases in hopes that this thing can be resolved through a continuous study over the years. That is the reason I wanted to know if ESSA was collaborating with the Department of Interior. We did not have this information when the Interior witness was here and this came to my attention last evening. I wanted to know to what extent we were collaborating with the Department of Interior in the preparation of these maps, because you did specifically mention in your statement that you now are in the process of making maps of the Continental Shelf beyond the Bering Sea. What is the objective of that if the Department of Interior is doing the same thing? Is the Department of Interior mapping the Continental Shelf beyond the east, west, and gulf coast of the United States?

Dr. WHITE. Some of the maps have been put out in the Department of Interior on very large scales as I indicated before and were drawn up on the basis of the data supplied from the Coast and Geodetic Survey. In the conduct of new surveys in areas where we have not had data we are working very closely as in Alaska with the Geological Survey to provide maps where they are required for their programs.

Mr. LENNON. In other words, Doctor, you are assuring this committee that there is such rapport and cooperaton between the other agencies of the Federal Government, the Department of Interior, the Coast Guard, and the others who are involved, HEW, the Corps of Engineers, and that there is no overlapping, particularly in the field of preparation of maps related to the same subject matter.

Is that true?

Dr. WHITE. That is true, Mr. Chairman. We are in contact with the other agencies constantly. As a result of the establishment of this new committee, which I chair, dealing with ocean exploration and environmental services, it is our hope that we could place the total mapping program for the oceans on a systematic basis with a long term plan. That will be one of the tasks of this interagency committee, to keep tabs on that problem and assure we have a good national program.

Mr. LENNON. I note on page 7 in your last paragraph——

Mr. POLLOCK. If the distinguished gentleman from North Carolina would yield for a moment, the Malta agreement, as I understand, or proposal, concerned those areas of the ocean depths beyond the Continental Shelf rather than involving the Continental Shelf. Is that correct?

Mr. LENNON. I am trying to find out. Do you want to comment on that, Doctor?

Dr. WHITE. I believe the Malta proposal does pertain particularly to the deep oceans, sir.

Mr. LENNON. On page 7 of your statement you concluded in the last sentence of the last paragraph, Warning and Prediction, "Thus ESSA's forecast warning services are central to the Nation's marine existence."

In a discussion this morning with a staff member, who worked 15 years in the Navy's oceanographic program, he raised the question that to his knowledge the Navy was, to a reasonable degree, involved in forecasting and warning, too. I am sure there must be a distinction. How does ESSA's forecast and warning service differ so far as marine transportation is concerned from that which the Navy is engaged in today?

Dr. WHITE. The Navy environmental prediction activities are directed specifically at support of the fleet.

Our marine environment prediction activities are directed at the general public and all other civil activities. These are very closely coordinated within the Office of the Federal Coordinator for Meteorological Services and Supporting Research, in which plans are drawn up, in which you have various agency's participation in the exchange of data and the preparation of forecasts. There is under preparation now a national marine weather plan within this office.

In other areas of weather, we have the same kind of situation. For example, the Air Force is very much concerned with the forecasting of weather conditions for aviation. They maintain in their air weather service a weather forecasting service. These are brought together within this Office of the Federal Coordinator so that overlap and duplication are eliminated and you do have a coherent national program in these areas.

Mr. LENNON. Can we speak to the missions and role of the Coast Guard particularly related to its ocean duty station cutters and the loran stations? What is the mission and purpose of the loran stations manned by the Coast Guard in areas of the world where we keep on duty at all times Coast Guard cutters for the role of warning and forecasting both to marine transportation and aviation? How does that coordinate with what you are doing in your forecast and warning service for the Nation's marine existence? You have just described the difference between that and the Navy. Will you describe the difference between what you are doing in this field and what the Coast Guard is doing in this field?

Dr. WHITE. The loran system operated by the Coast Guard is a navigational system which is used by everybody who has to operate on the high seas.

Mr. LENNON. Your ESSA does not have anything presently that does the same thing.

Dr. WHITE. No, sir; we do not.

Mr. LENNON. You do not contemplate anything?

Dr. WHITE. No, sir; we do not. The ocean station vessels of which there are six, four in the Atlantic and two in the Pacific, were established by international agreement under the International Civil Aeronautics Organization. This is a program participated in not only by the United States but by other countries in the Atlantic and Pacific. These stations were originally used as navigation checkpoints, for air-sea rescue, and many other functions. They still have multiple functions. One of the functions of these stations and a very vital one is to provide us with weather data. They take upper air soundings from these ships. The personnel who take the soundings are ESSA personnel operating on board Coast Guard ships.

Mr. LENNON. Thank you, Doctor, for that explanation. So frequently and as recently as the consideration of the appropriation act, some of the members of the Appropriations Committee raised these very questions. I wanted to get it in the record. Now we will move to the oceanographic vessels as such. You have how many now?

Dr. WHITE. May I turn this question over to Admiral Jones, sir?

Mr. LENNON. Thank you.

Admiral JONES. We have a total of 15 vessels in ESSA's fleet, of which two may be considered as outstanding oceanographic research vessels.

Mr. LENNON. The other 13 are not in any degree engaged in research regarding the marine science, or oceanology.

Admiral JONES. No, sir the remaining 13 ships are engaged part time in oceanographic research and oceanography operations. Their main mission is, however, hydrographic surveys.

Mr. LENNON. Admiral, I am sure you know in what special fields the oceanography vessels of the Coast Guard are involved. And, how many do they have?

Admiral Jones. The Coast Guard is engaged in oceanography in connection with their weather stations and ice patrol operations. The Coast Guard does some bathometric surveys in deep ocean areas, some ocean station operations and some geophysical and oceanographic investigations. The data obtained is made available through the National Oceanographic Data Center. The exact number of vessels engaged in full-time oceanography is unknown.

Mr. Lennon. Some of their ocean station vessels, other than purely oceanography vessels, are also engaged in some degree of oceanography.

Admiral Jones. That is correct, sir.

Mr. Lennon. How many oceanography vessels does the Department of Interior have, even though related to the fisheries?

Admiral Jones. According to information available to us, Department of Interior has 19 oceangoing vessels of which 17 are operated by Fish and Wildlife Service.

Mr. Lennon. Were any or all related to oceanography outside of the general sphere of fisheries, or are they all directly related to fisheries?

Dr. White. Mr. Chairman, if I could answer that question in this way, which may or may not be satisfactory, operating a vessel at sea is tremendously expensive. That means, whenever one has a vessel at sea for any purpose, whether it be a Coast Guard vessel or ESSA vessel or Interior vessel where the primary mission may be for a purpose other than oceanography, it is highly advantageous to make use of that platform in acquiring other kinds of data to be used for other purposes. I would feel that almost all of the vessels dealing with any aspect of marine science or another in our national inventory at one time or another do take additional observations over and above that of its primary mission. This is one way in which we get multiple use out of these ships and acquire data in a very economical manner.

It would be very difficult to make a specific statement on this, except to say that all vessels out there, and this is true even of merchant ships, where they have many, many platforms at sea, not operated by the Federal Government, which can be used for oceanographic observations and are so used. This is one of the ways that we can gain a lot of oceanographic information at very little cost.

Mr. Lennon. Thank you very much, Doctor. I wanted to get that on the record because it is not even understood by the members of the Appropriations Committee of this Congress, some of whom have been here as much as 16 years. I wanted to get your statement and the admiral's statement on the record.

As I indicated, just in the consideration of the appropriation bill in the Independent Offices, this very question came up on the floor and it was not answered adequately, at least to the satisfaction of the members of the Appropriations Committee.

Counsel, do you have any questions?

Mr. Drewry. Yes, Mr. Chairman.

Dr. White, what is the present time cycle from completion of a survey to publication of a chart based on the survey? In other words, how up to date are your Continental Shelf and other Coast and Geodetic Survey charts?

In 1965, Admiral Karo testified that the normal cycle was from 1 to 2 years, but that with new automated processes it was hoped that the time would be shortened down to a few months. In the past we have heard that the publication of chart information has been as much as 6 years after collection of the data.

Dr. WHITE. An average time of 1 to 2 years is still required from completion of a hydrographic survey to publication of a chart based on that survey, because ESSA has not had the necessary resources to implement the automated data processing system. The most critical data, about 40 percent of the complete survey, is applied to the chart during this 1- to 2-year period. The remainder is applied over the next 3½ years or so. As a result only about 40 percent of the available hydrographic survey data is presently being applied to the charts.

Mr. DREWRY. What progress has been made in the past several years in the small boat chart program? What areas are now covered? How are they being received by the public?

Dr. WHITE. The first Coast and Geodetic Survey small-craft chart was published in 1959. Today 59 are on public issue. However, 20 of these are of the area type; that is, conventional nautical charts folded, overprinted with additional information for small-craft and issued in a suitable jacket. One hundred and forty additional new small-craft charts are needed to cover navigable waters frequented by small-craft. Small-craft new chart production was limited to five charts in fiscal year 1967.

The coverage of present small-craft chart areas along the east coast includes:

Beginning in Maine, Penobscot Bay and River, Damariscotta, Sheepscot and Kennebec Rivers.

In Massachusetts, Boston Harbor; Cape Cod Canal, Buzzard's Bay and the southside of Cape Cod.

In Rhode Island, Narragansett Bay.

In Connecticut, New York, and New Jersey.

Coverage is complete from the New London, Conn. area to Cape May, N.J., including the inland waterway, except for the east end of Long Island.

In Maryland and Virginia (Chesapeake Bay) coverage includes Chesapeake Bay North of Solomons, Md., Potomac River and Rappahannock River.

In Virginia, North Carolina, South Carolina, Georgia, and Florida coverage is complete from the Norfolk, Va., area to the Florida Bay, Marathon Key, Fla., area, including Albermarle Sound, Savannah River, and St. Johns River, but excluding Pallico Sound. Also in Florida the coverage includes the St. Lucie Canal, Lake Okeechobee, the Caloosahatchee River, and the west coast of Florida from Fort Myers to Tampa Bay.

In Florida, Alabama, Mississippi, and Louisiana, the small-craft charts cover the inland waterway from Nensacola Bay, Fla., to Bayou Lafourche, La. Also covered in Louisiana is Calcasieu Lake.

In Texas, Galveston Bay and the inland waterway from there to Matagorda Bay are covered.

In the Western United States small-craft charts are published for San Pedro Channel and Bay in Southern California, for Lake Mead in Nevada and Arizona, for the San Francisco and San Pablo Bays, the Sacramento and San Joaquin Rivers in northern California, and for Puget Sound and the San Juan Islands in Washington.

Coastal and Geodetic Survey small-craft charts, designed for cockpit use on recreational boats or as hand held copies on the bridges of commercial vessels have received very favorable acceptance by the boating public. The populatrity of these charts is indicated by the sale of 194,988 in fiscal year 1967. The two most popular small-craft charts are 824–SC and 826–SC covering the New Jersey coast, with sales of 12,738 and 10,369 respectively in fiscal year 1967.

The issue of new small-craft chart coverage for an area does not adversely affect the issue of existing conventional chart coverage for the same area.

It follows, that the large issue of small-craft charts is stimulating chart use for safe navigation by the Nation's 8 million recreational boats, who have spent $2.8 billion in 1966 on boating.

Mr. Drewry. In the past we have inquired about the extent to which the Coast and Geodetic Survey has cooperated with offshore industries, with particular reference to taking advantage by contract or otherwise of the extensive survey-type information, including bottom topography, collected by the commercial geophysical industry in such areas as the Gulf of Mexico. We have been told by industry sources that they would be happy to help the Coast and Geodetic Survey from avoiding duplication of effort by furnishing certain types of general oceanographic survey information they have acquired in connection with their geophysical survey. I gather that the Coast Survey feels that industry acquired data is not in accordance with your requirements of production of navigational topographic charts. Nevertheless, it seems to me that there are prospects in this area well worth exploring in the interests of greater economy and efficiency.

Dr. White. Certainly these are prospects well worth exploring. In fact, ESSA is investigating the possibility of acquiring hydrographic data from commercial sources. As an example, in the Gulf of Mexico area, the Coast and Geodetic Survey obtained sample hpdrographic information from the Independent Exploration Co., of Houston, Tex., for evaluation. The depth information offered, at $2 per sounding, was essentially a byproduct of a gravity survey and did not meet Coast and Geodetic standards for a basic hydrographic survey or for nautical charting or bathymetric mapping, in either data density or continuous profile depth record. It was suggested that limited amounts of this information might be purchased for selected areas to help establsh the rate of bottom changes and to assist in survey planning.

Last year, a Coast and Geodetic representative contacted, among others. Chevron Research, LaHabra, Calif., to determine the availability of useful, industry-held hydrographic information. He found that Chevron and others possess thousands of miles of gravity-seismic profiling, with continuous graphic profile depth recording, along the U.S. west coast, to 100 or more miles seaward. The vast majority of the depth data has not, however, been processed as depth information. It was subordinate to the seismic-gravity profile which was obtained in most instances from a towed platform 1,500 feet behind the vessel and all processed data reflects the platform position, not the towing vessel on which the depth information was generated. All position and depth data would therefore have to be reprocessed by the Coast and Geodetic Survey, utilizing the original raw data on magnetic tape. As you can see, the acquisition of data that must be reprocessed would further overload our presently inadequate processing system, but would not overload the automated system we propose to acquire and implement.

Mr. DREWRY. On page 14 of your statement, you said: "Observations from 800 merchant ships are received daily * * *" Would you elaborate on this statement? What is the procedure for the collection and transmission of the observed data? Are you referring to 800 particular ships? Are they American, foreign, or both? What is the extent of the observations?

Dr. WHITE. The 800 ships referred to in the statement are actually the average number of weather reports received daily by the Weather Bureau from weather reporting ships of all nations while in the western North Atlantic and eastern north Pacific. These weather messages are coded reports showing ship's position, time, hydrometers (rain, fog, and so forth) wind, temperature of air and sea, dewpoint, barometric pressure, visibility, and state of the sea surface (wave and swell).

American ships reporting include merchant marine, Navy, Coast Guard, Military Sea Transport, commercial fishing vessels as well as from Coast and Geodetic Survey and other research vessels. The 800 reports mentioned include messages sent at the four 6-hour synoptic map periods and special observations sent during storms. These messages are sent by radio by the ships to commercial and Government coastal radio stations which relay them by landline to NMC, Suitland, Md., and WBAS, San Francisco. There the reports are grouped in collectives and transmitted to all Weather Bureau offices on the Service C teletypewriter circuit.

Weather Bureau communications centers also transmit the collection of ship weather reports to the meteorological service of other nations over international weather teletypewriter circuits; likewise the Weather Bureau receives ship collectives from other countries over the same channels.

Mr. DREWRY. What is the present status of the oceanwide survey program recommended in the original National Academy of Sciences' Committee on Oceanography report? And subsequently, under guidance in the ICO?

Dr. WHITE. The oceanwide surveys plan appears as chapter 9 of "Oceanography 1960 to 1970," published in 1960 by the Committee on Oceanography of the National Academy of Sciences (NASCO). This plan, with minor differences, bears the title "National Plan for Ocean Surveys" in pamphlet No. 7 of the Interagency Committee for Oceanography, published in May 1963. The descriptive acronym SEAMAP (for Scientific Exploration and Mapping Program) was later coined for the program.

The Coast and Geodetic Survey (now ESSA) has done nearly all of the survey work on SEAMAP to date. The surveyed area covers a little over 1 million square nautical miles, or about 1 percent of the world's oceans. This represents roughly 3 percent of the U.S. share of oceanwide surveys, as envisioned by NASCO. Maps covering this area (in the north Pacific Ocean) will be published in the near future.

ESSA intends to continue SEAMAP survey work at the rate of at least 1½ ship-years per year. This equates to about 600,000 square miles per year, a rate which would complete the U.S. share of world ocean surveys in about 50 years. More rapid ESSA progress is inhibited by lack of resources.

Mr. DREWRY. On page 20 of your statement you referred to "an improved and automated data process system for mapping and charting is under development." Would you briefly describe the details of the new system?

Dr. WHITE. Simply put, the automated system is one which will substitute computerized or mechanized operations for manual operations wherever this will result in savings in money and time without loss of product integrity. In the new system, raw survey data will be automatically or semiautomatically logged into digital form and then machine-reduced into smooth data form by application of known corrections for depths and position. These steps will be accomplished aboard ship, as are the present manual counterpart operations.

The smooth data, in digital form, will in turn be furnished to a central processing office where it will be used with automated equipment which will accomplish the cartographic drafting necessary for survey verification and for final cartographic manuscript compilation. Most of the repetitive manual operations will be eliminated, although human decision and evaluation inputs which bear on the final accuracy and completeness of the end product will be retained in the system.

Efficient and effective marine data processing requires the implementation of automated techniques to replace the shortages and shortcomings of present day manual techniques. The desirability of an automated cartographic system can easily be demonstrated. It is now known that nearly 100 percent of data reduction can be done by machine, and machine reduction is 1,000 times faster than by man. In addition, 80 percent of the cartographic drafting can be done by machine, at a rate 40 times faster than by man. The end result, in the new system, will be full application of survey data to a new chart in 6 months, rather than partial application in somewhat over a year as is now the case. Economic savings reported by DOD agencies using automated techniques indicate an average savings in cartographic compilation techniques of 63 percent. These anticipated savings will increase as the system is more fully implemented.

Mr. DREWRY. That is all, Mr. Chairman.

Mr. DOWNING (presiding). The next witness will be Mr. Robert Abel, Director, Sea Grant College Program, National Science Foundation.

STATEMENT OF ROBERT ABEL, DIRECTOR, SEA GRANT COLLEGE PROGRAM, NATIONAL SCIENCE FOUNDATION

Mr. Abel. I should like to introduce Dr. Randall Robertson, Associate Director of the National Science Foundation and Mr. Charles Maechling, Jr., Deputy General Counsel.

Mr. Chairman, I have a prepared statement which I would like to introduce for the record, but time does grow short and with your permission I would speak from it.

Mr. Downing. You may proceed as you wish, Mr. Abel.

(The statement follows:)

Statement of Robert B. Abel, Head, Office of Sea Grant Programs, National Science Foundation

Mr. Chairman, gentlemen, I am happy to appear before you this morning to discuss the progress of the National Sea Grant Program. Because you are all familiar with the early history of its concept and formation, I propose to concentrate on more recent developments, following the passage of the Sea Grant Act on October 15, 1966, and its signing into law on October 17, 1966.

During the three months following the Act's passage, the National Council on Marine Resources and Engineering Development considered the program and endorsed the National Science Foundation's plans for its implementation. A budget level of $4 million was established for Fiscal Year 1968. In its first report to the President, the Marine Science Council stated that the Sea Grant Program, highlighted as a new initiative, would be implemented immediately. Chapter 6 of the Council's first report, "Marine Science Affairs—A Year of Transition," placed the program in the perspective in which it would be viewed and implemented by the Executive Branch of Government. I would like to offer that chapter for the record.

Coincident with the issuance of the Council's report, the National Science Foundation established the Office of Sea Grant Programs, reporting directly to the Associate Director for Research. During the ensuing months, staff members were hired; at the present time the staff is complete, with the complement shown on this table, which I offer for the record.

I might add that acquiring the proper staff was not simple. It was necessary to obtain a high level of competence and broad experience, with a combination of backgrounds that would cover the great scope of the Sea Grant Program. The nature of the program also required that the staff be imaginative, because it became clear very early that many institutions were looking to the staff for broad guidance and for specific ideas on useful activities. We interviewed a number of top-notch people. Finally, we arrived at what I consider a happy combination of staff talents and personalities.

During the period of program organization, inquiries poured in from institutions of all kinds, and the demand for information on the program grew rapidly. However, the program could not begin officially until funds were available. It was not until June of 1967 that the Congress approved the Foundation's request to re-program $1 million of its previously appropriated funds with which to get the program underway. Immediately thereafter, on June 8, 1967, the Foundation issued the official announcement of the program—*Important Notice to Presidents of Universities and Colleges.* Subject: *The National Sea Grant Program.*

This announcement, which I would like to offer for the record, included the general program considerations, concept, objectives, and scope. It outlined the generalized criteria under which proposals would be judged, and the method of administration.

The National Science Foundation plans to administer the program in two main divisions:

Sea Grant Institutional Support will be focused in institutions engaged in broad-based marine resources program that include research, education, and advisory services—that is, all three major elements prescribed under the Sea Grant

Act. These institutions are expected to provide leadership, and scientific and technological resources for marine activities within their regions. In time, supported institutions which establish a record of excellent, sustained performance toward Sea Grant goals will be officially designated "Sea Grant Colleges."

Sea Grant Project Support will be given to individual projects which generally will be single, well-defined research, study, design, education, advisory service, or training activities expected, in accordance with the Act, to produce information, techniques, methods, or systems applicable to marine resources in any field, or to train manpower required for marine resource exploitation.

In August, after resolution of a number of major policy and procedural questions, the Foundation issued its official brochure containing specific suggestions for submission of proposals for Sea Grant Support. I should like to offer the brochure for the record. To spell out specific requirements was not an easy task. For instance, the popular notion of Sea Grant Institutional Support as being tantamount to the designation of a Sea Grant College was not easy to dispel in words. Making the brochure consistent with NSF's established procedures and Federal fiscal regulations while maintaining the flexibility of the program and anticipating the problems and requirements of supported institutions took considerable time. The Foundation naturally discouraged submission of proposals until the guidelines had been published. Nevertheless, several proposals were received informally, and a few were submitted formally. The formal proposals are now in review. Draft proposals have been sent to the Foundation staff and experts from other agencies for informal comments which will be used as the basis for preliminary guidance to the proposers.

The Foundation has formed two advisory panels. About 50 persons have been invited to participate in a proposal review panel for Sea Grant Projects. This will be a panel from which the Foundation may select task teams of specialists to review individual proposals. In addition, the Foundation has invited nine eminent representatives from universities and industry to serve on the Sea Grant Institutional Support Panel. Because of the wide competence of the members of this panel, the Foundation expects to be able to look to them for general program guidance as well. When all acceptances have been received from the panelists, the Foundation will announce the membership of both panels. At that time, I would appreciate the opportunity of submitting the lists to you. You will find them, I believe, an excellent mix of high competence from the academic, industrial, and government ocean communities.

Since, as authors of the Sea Grant Act, you gentlemen are already conversant with its provisions, I have skipped over the rest of the mechanics of the program's implementation.

Now, Mr. Chairman, I should like to make six points of a general nature: First, the Sea Grant College and Program Act of 1966 presents an extremely broad mandate to the Executive Branch. As a matter of practical development, the Foundation has decided to emphasize applied research and training of engineers and technicians rather than basic research or education of scientists: we felt this to be the sense of Congress from the various committee reports and hearings. Further, we feel that the available funds will be more usefully employed in this area rather than in the basic research already covered by other sectors of the National Science Foundation and by several other Federal agencies.

Second, in some ways the most critical problem concerns the interface between the Sea Grant Program and the mission-oriented agencies. Where, for instance, does the Bureau of Commercial Fisheries leave off, and the Sea Grant Program begin? In order to maintain flexibility in the program, we have decided to resolve questions informally, through very close working-level relationships with key people in our fellow agencies. Arrangements have been made with all of the Federal agencies to allow quick and easy exploration of each case on its own merits. For instance, I enjoy close contact with Assistant Secretary Cain in Interior, with Dr. White, Administrator of the Environmental Science Services Administration in Commerce, and with Assistant Secretary Frosch in the Navy. These informal arrangements also can provide immediately the service of experts in these agencies who can assist in evaluating the proposals.

Third, we are now in a position for effective action on proposals which, after all, form the essential building blocks of the program. We hope to be able within a very few months to report on the first grants made and the substantive nature of the kind of projects and institutional programs being encompassed. At that time, I should like to submit a further report to you.

Fourth, the Sea Grant Program has aroused significant interest across the nation. State agencies, industries, colleges, and local and Federal facilities are combining their interest and capabilities to plan joint programs. Several industrial firms have declared their intention of providing facilities, scholarships, fellowships, and lecturers to schools expecting to participate in the Sea Grant Program.

Interstate communications have resulted from this program. Several universities are planning the formation of consortia to pursue joint projects and to hold regular planning meetings. Several national societies have either formally or informally placed their collective and individual skills at the disposal of universities desiring to pursue practical projects under the National Sea Grant Program. Schools of agriculture in several of our finest universities have indicated their interest in encompassing aquaculture as well. We have prepared a table depicting the number of schools in each state which have requested information from which to prepare Sea Grant proposals. I should like to offer this for the record.

Interest in the Sea Grant Program already indicates the proposals will, in both number and size, far exceed our ability to fund all useful projects or to give all qualified universities significant institutional support grants. Obviously, the program will be extremely competitive and will pose a difficult task for our evaluation panels. We expect that industry, business, universities, both four-year and two-year colleges and technical schools, state agencies, and the public will follow the development of our program with intense interest. It seems already clear that the program is serving as a catalyst to initiate actions at various levels of industry and government which will have an effect on nearly all aspects of the national interest in the sea.

Fifth, fiscal planning presents a problem. The President's budget for Fiscal Year 1968 included $4 million for the Sea Grant Program. Although we would all like to see this program grow, its rate of growth must be determined in the context of national policy; and, as you are well aware, competition for the Federal dollar can be expected to be extremely keen during the forthcoming year. As to the future, should funds be available, I believe the program might grow to perhaps an annual level of approximately $25 million in the next four or five years. It is clear that the Institutional Support Program will be both rewarding and expensive. Sea Grant Project Support will start at a relatively modest cost and grow, because the initial proposals now in preparation are in many cases feasibility studies, curriculum developments and definition studies that will lead to more expensive projects in later stages.

Sixth, Mr. Chairman, the issue which is to me the most critical of all, concerns the nation's view of this young program. It is apparent from some of the correspondence and attention we have received, that Sea Grant implies to some a panacea to cure all of the ills connected with oceans development which, in turn, judging from the acclaim often given to the National Ocean Program, may be expected to cure all of the ills of humanity. This is not to be. *Any and all research and development in the oceans must be considered in very, very long range context.*

In considering the future of the Sea Grant Program, my natural optimism as a program manager must be tempered by experience and knowledge of the essential nature of the ocean. I would not, under any circumstances, want to mislead you into looking for pay-off from the Sea Grant Program within the next couple of years. In fact, realism dictates that really significant pay-off is at least a decade in the future, although useful results will be achieved before that time, including graduation of some applied manpower. Our initial objectives must mainly concern the building up of the resources from which we are to accomplish practical exploitation of the seas rather than exploitation itself. This building up of resources is something to which the Sea Grant concept is admirably suited, and it is a goal which we approach with considerable enthusiasm.

Ever since the program's inception, I have been deluged with demands highlighting above all else, desperate need for ocean technicians—persons competent to go to sea, to make observations, to record data, to process data, to run instruments, to repair instruments, and to assist in the construction of oceanographic apparatus of all kinds. This is a prime mission to which we in the Sea Grant Program are already addressing ourselves. We hopefully predict significant output of technicians in about three or four years.

In conclusion, Mr. Chairman and Gentlemen of the Committee, the excitement, the interest, and the reorientation of institutions to pracical problems of the oceans already have shown the potential effect of the National Sea Grant Program on the nation's welfare. You, and your counterparts in the Senate, have created what can become a superb vehicle for involving academia, industry, business, national organizations, and State and local governments in cooperative ventures to exploit and to use the marine environment in most productive and useful ways. You have created a program which serves as a catalyst, to bring together groups which have much to offer jointly, but which do not normally communicate. You have created a mechanism of great scope and flexibility which can serve to fill many of the important gaps remaining after the implementation of the programs of the mission-oriented agencies. Perhaps most important of all, through the National Sea Grant Program you have given new incentive and new hope to many dedicated people who have wanted to solve economic, legal, manpower, technical, and scientific problems of marine resource development, and who have lacked support—in many cases only a little support—and encouragement to get on with the job. It is up to the Sea Grant staff, and our associates in the Foundation, to realize the truly enormous potenial of the Naional Sea Grant College and Program Act. I can only assure you that, with your help, we will do our very best.

Mr. Abel. I am most happy to appear before you this morning to discuss the status of the national sea-grant program. Of course, you are all familiar with the history of its concept and formation. Therefore, I would propose to concentrate on the more recent developments which followed the passage of the Sea Grant Act on October 15, 1966, and its signing into law on October 17 of the same year.

During the 3 months following the act's passage, the National Council on Marine Resources and Engineering Development which has been mentioned here several times this morning considered this program, considered the National Science Foundation's plans for its implementation and endorsed these plans to the President. At that time a budget level of $4 million was established for the executive budget and in its report to the President, the Marine Science Council stated that the sea grant program should be implemented immediately and endorsed it as one of their new initiatives.

Chapter 6 of that report entitled, "Marine Science Affairs, a Year of Transition," placed the program for the first time in the perspective in which it would be viewed and implemented by the executive branch of the Government. Accordingly with your permission, I would like to offer that chapter for the record.

Mr. Downing. Without objection, it will be incorporated in the record.

(The information follows:)

Chapter VI

IMPLEMENTING SEA GRANT LEGISLATION

Perspective

The National Sea Grant College and Program Act of 1966 established a new instrument for strengthening the base of specialized education and ocean engineering research, and for improving communication of scientific or technological results to many marine science interests lacking their own research capabilities. This Act is one of the areas of special emphasis selected by the Council and will be implemented by the National Science Foundation as soon as authorization to use fiscal year 1967 funds for this purpose is secured from the Congress.

It is widely agreed that advances in science and technology depend on skilled manpower. In recent years, the Federal Government has assumed major responsibility—through a variety of fellowships, traineeships, and research and institutional grants—to support training and education in many technical fields, thus increasing the flow of new scientists and engineers to meet national needs. This Federal policy has strengthened the marine sciences. Professional manpower in marine sciences in 1961 was limited, totaling only 600 persons, trained mostly in a variety of classical disciplines, and in oceanography. Accordingly, special steps were taken in 1961 by several Federal agencies to expand the opportunities at universities for students, teachers, and graduate research. Today, professional manpower numbers 2,600 and nearly 1,000 individuals are enrolled in marine science curriculums in more than fifty colleges and universities.

It has become increasingly apparent, however, that this support of marine science was not adequately complemented by parallel support for the training of engineers who would engage in marine work. It also became apparent that applied marine research was not being supported adequately, compared to basic marine research. Finally, in the context of the broadened emphasis being placed on the civilian as well as military importance of using the seas, there was a conspicuous gap in the important process of information transfer between the Federal Government, States, departments within academic institutions, and certain sectors of industry.

Purpose of the Act

It was in this situation in 1966 that the Congress, recognizing the need to strengthen the Nation's capabilities in marine science and technology, with particular emphasis on ocean exploitation, passed the National Sea Grant College and Program Act (Public Law 89–688) which was signed into law October 15, 1966. The legislation amended the Marine Resources and Engineering Development Act and became the first operating program provided under the basic legislation.

The purpose of this Act is threefold—to strengthen the pool of trained manpower, to strengthen applied research, and to improve the process of information transfer.

Attainment of these objectives will be a long-term process, for the needed manpower resources cannot be developed quickly. But the Sea Grant Act is intended to begin the move toward those objectives and, ultimately, to accelerate application of scientific discoveries to all fields relating to the seas: defense, shipping, food, prospecting and mining, pharmaceuticals, transportation, recreation, weather prediction, and other useful areas.

The National Science Foundation is charged by law with initiating, developing, and supporting the programs authorized by the Sea Grant Act. The Marine Sciences Council is required to advise the Foundation with respect to the policies, procedures, and operations of the Foundation in carrying out its functions.

As a matter of policy, the Council and Foundation agreed that the sea-grant program should be largely oriented to national purposes, such as those dealing with food from the sea, ocean-related environmental forecasting, Continental Shelf exploitation, and multiple use of the seacoast (specifically addressed to pollution problems). The Council also recommended that existing legislative authorization for two years, ending fiscal year 1968, be extended for another finite interval of at least two years.

Features of the Program

In some respects the Sea-Grant concept is similar to existing programs, but in its mode of support, the Sea-Grant concept is new. Its novelty derives both from its focus on ocean engineering and, as suggested in Figures 11 and 12, on its cross-disciplinary and information transfer elements. Figure 11 is a traditional, two-dimensional view of ocean training, with disciplines matched against fields. Our purpose in representing ocean training on a three-dimensional grid, as in Figure 12, is to show that the Sea-Grant concept embraces a greater number of disciplines, including law, economics, and so on, and that

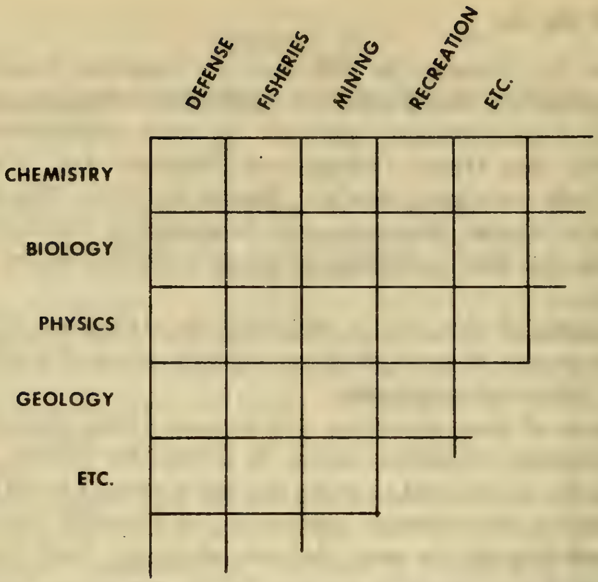


FIGURE 11.—*Two dimensional pattern of conventional ocean training.*

it is the collaborative effort of all these skills that will give the total marine enterprise its strength.

The Sea-Grant Program will be carried on in the universities, but there will be continuous interaction between the Federal Government, State governments, academic institutions, and industry to examine common problems and to pool diversified resources, facilities, and specialized talents for their solution. The program would thus augment rather than replace existing programs of support—and provide a "cement" for these ongoing efforts. It could provide excellent opportunities for "seed projects" that will attract private funding participation.

Industrial firms in widely diverse fields could participate in the program, enabling students to pursue on-the-job training in conjunction with their normal educational programs. Industrial requirements will help to shape the direction of the program and, indeed, the National Science Foundation looks to industry for the feedback so essential to accurate planning. Thus, the Sea-Grant Program will help to support existing industries through provision of trained manpower, new techniques, and concepts.

In short, the Sea-Grant legislation provides for grants and contracts to public or private institutions of higher education, institutes, and laboratories for the functions of education, applied research and information transfer aimed at marine resource development. Matching funds equal to half of the Federal grant or contract; i.e., one-third

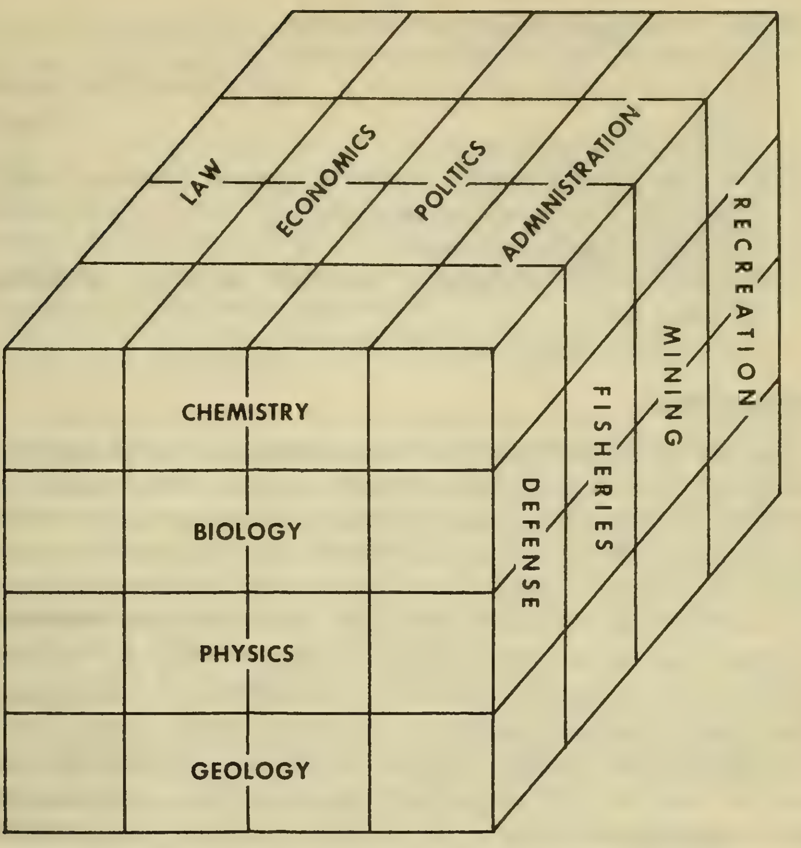

LAW
ECONOMICS
POLITICS
ADMINISTRATION
RECREATION
MINING
FISHERIES
DEFENSE
CHEMISTRY
BIOLOGY
PHYSICS
GEOLOGY

FIGURE 12.—*Sea grant training—a three dimensional pattern.*

of the total, must be provided by the recipient. Federal funds may not be used for construction of new facilities or rental.

Participants in any one State may not receive more than fifteen percent of the total appropriation to the Foundation for the Sea-Grant Program in any single fiscal year.

Funds are authorized for support of programs at Sea-Grant Colleges and at other suitable institutions. The term "Sea-Grant Colleges" is defined in the Act as encompassing public or private institutions of higher education which engage in a comprehensive set of related activities focused on resources development. Sea-Grant Programs, on the other hand, may embrace individual projects to meet any one of the three functional goals; i.e., trained manpower, applied research, and information transfer.

Although it is too early to describe the precise nature of the program, typical features could include the following:

—Location in a region with marine-related industry (e.g., fishing, boating);

—Full-time program director/coordinator;
—Evidence of support by host institution;
—Regular, part-time participation by faculty from allied departments;
—Defined study curriculum;
—Planning devoted at least partly to regional problems such as utilization of local marine resources;
—Programs of applied research;
—Related public information activities including workshops, seminars, etc.;
—Provision for multi-institutional collaboration.

Implementation

Sea-Grant College support will be granted to a limited number of institutions that qualify competitively to carry out comprehensive programs in both training and technology. They must have the ability to undertake advisory programs related to development of marine resources. Support will be provided successful applicants by means of a single broad grant to an institution. The appellation "Sea-Grant College" may be conferred upon an institution after the formative phases of the program and visible accomplishment. However, to achieve any degree of effectiveness, this three-faceted (research, training, information transfer) program anticipates considerable continuity of support. Within limits of appropriations, continuing support for a comprehensive Sea-Grant College program in an institution would ordinarily be provided as long as high-quality performance is maintained. Reviews will be conducted annually, and levels of support will depend on both promise and achievement.

The law stipulates that grantor contribution will be limited to two-thirds and that the grantee must provide at least one-third of funds required for an approved program. Institutions will be encouraged to provide even greater amounts, particularly from private sources.

Funding

For fiscal year 1967, the Congress is being requested to authorize the National Science Foundation to reallocate $1 million from its current regular appropriation to initiate the program. This would permit several small grants to begin activities at participating institutions, especially for necessary planning.

For fiscal year 1968, $4 million is being requested of the Congress. With such funds, the Foundation would provide grants up to several hundred thousand dollars each (supplemented by cost-sharing funds provided by the recipient) to several institutions. These funds will be used to support both comprehensive college programs and individual Sea-Grant projects.

Criteria

The National Science Foundation has developed, and the Council has endorsed, criteria by which proposals for such grants will be judged. These criteria, soon to be announced by the Foundation, are stated only in general terms, to encourage maximum flexibility and imagination on the part of applicants.

These criteria consider:

1. *Existing resources.*—The institution should have a substantial ongoing program in some area related to objectives of the Sea Grant Act, such as oceanography, marine biology, ocean engineering, etc. Additionally, any necessary facilities such as laboratory buildings, ships, and docks must be available, since the Act forbids Sea-Grant funding of such facilities. It must also demonstrate capabilities for interdisciplinary activities. In some cases, needed facilities might be provided by a consortium of institutions.

2. *Capacity for development.*—The institution should demonstrate the ability to plan and implement a new or augmented program. Each applicant will be required to submit a long-range plan, supported by appropriate statistical material, showing how its sea-grant activities will develop in relation to overall institutional plans.

3. *Commitment to program goals.*—Sea-Grant College support will be given only to those institutions which are prepared to conduct comprehensive programs encompassing the education, research, and information transfer objectives of the Act. This must be demonstrated not only by a willingness to share costs as required by the Act but by full commitment of responsible senior officials to an effective program. This commitment should be accompanied by a well-developed consideration of the proposed program's potential for contributing to the health and welfare of the Nation as well as to the Nation's economic strength in marine-related activities.

4. *Regional factors.*—Institutions conducting Sea-Grant College programs will be responsible for serving as regional centers for strengthening the marine resources utilization program. Each institution requesting support for a Sea-Grant College program will be expected to have examined thoroughly the needs and capabilities of its region. It must also consider national needs and services relating to the marine aspects of transportation, fisheries, mining, and other economic endeavors. Institutional programs will be expected to provide advisory services to regional economic and governmental interests as may be appropriate.

Under these criteria, program grants will be allocated within three major categories:

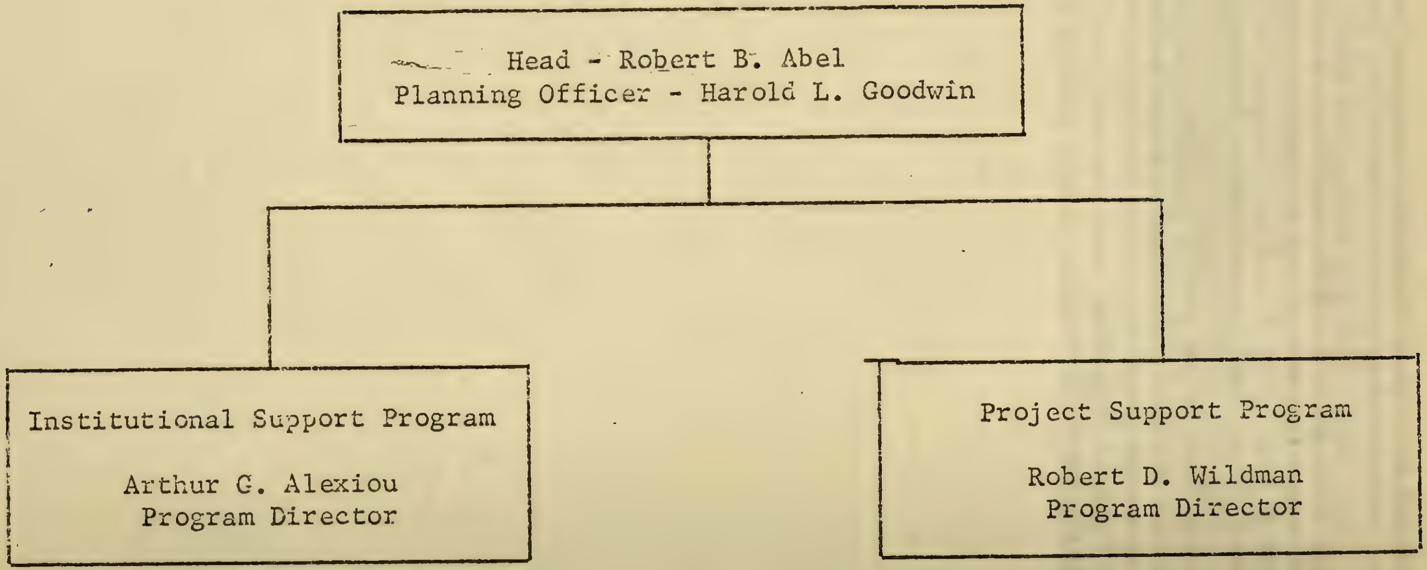
- Applied research to increase knowledge and skill and to improve techniques and equipment for use in development of marine resources;
- Training personnel at all levels—including two-year programs for technicians—who will participate in marine resource development;
- Marine advisory programs (information transfer) designed to aid persons currently employed or interested in marine resources development. Such programs would include, but not be limited to, workshops, advisory services, seminars, and demonstrations.

Mr. Abel. At the same time as this report was issued the National Science Foundation established the Office of Sea Grant programs, of which I am the head. This office was to report directly to the Associate Director for Research, Dr. Robertson. At the same time the selection of staff began. This was not easy inasmuch as since it was naturally desirable to keep this staff small and owing to the immense breadth of scope of the act itself, we were looking for people of large breadth of knowledge, with plentiful imagination and initiative. We now have the staff on board. There are four professional persons, including myself. I have their list tabulated and with your permission would offer it for the record as well.

Mr. Downing. Very well.

(The tabulation follows:)

NATIONAL SCIENCE FOUNDATION
National Sea Grant Program


Head - Robert B. Abel
Planning Officer - Harold L. Goodwin
Institutional Support Program
Arthur G. Alexiou
Program Director
Project Support Program
Robert D. Wildman
Program Director

Mr. Abel. Although there was a rather large response to the first announcements of the program and the act itself, the Science Foundation clearly could not begin the program until the funds were made available by the Congress. This occurred in June when the Congress approved the Foundation's request to reprogram $1 million of its own funds. Then immediately following on June 8, the Science Foundation issued a document which was sent to all of the colleges in the United States. This was the official announcement of the program's existence. It outlined rather broadly the aims of the program, its scope, and alluded then to a brochure to be forthcoming, which would offer the guidelines under which proposals for participation in the program could be most effectively prepared. I should like to offer this announcement for the record.

NATIONAL SCIENCE FOUNDATION
OFFICE OF THE DIRECTOR
WASHINGTON, D.C. 20550

June 8, 1967

IMPORTANT NOTICE

to

PRESIDENTS OF UNIVERSITIES AND COLLEGES

Subject: THE NATIONAL SEA GRANT PROGRAM

On October 15, 1966, the President signed Public Law 89-688, the NATIONAL SEA GRANT COLLEGE AND PROGRAM ACT, for the purpose of accelerating national development of marine resources through support and encouragement to academic institutions, research institutes, and laboratories. In order to accomplish the purposes of the Act, the National Science Foundation has established two related programs under a new Office of Sea Grant Programs: a program of *Sea Grant College* support, and a program for support of specific *Sea Grant Projects.*

Sea Grant College support will be focused in institutions engaged in broad-based marine resources programs that include research, education, and advisory services. Such institutions should provide leadership and scientific and technological resources for marine activities within their regions.

A *Sea Grant Project* will be a single, well-defined research, study, design, education, advisory, or training activity expected to produce information, techniques, methods, or systems applicable to marine resources in any field, or to train manpower required for marine resource exploitation.

More detailed descriptions of Sea Grant College and Sea Grant Project support are given starting on page 2.

GENERAL CONSIDERATIONS

The National Sea Grant College and Program Act was passed to augment other important legislation designed to accelerate effective utilization of marine resources. The intent is to supplement and expand other Federal activities through three major categories of effort:

—Research directed toward accumulation of knowledge necessary for development and beneficial exploitation of marine resources.

—Training, at all levels, of manpower required for marine resource development and exploitation.

—Advisory services for communicating to natural and social scientists, technologists, industrialists, businessmen, and the general public, information related to marine resource development and utilization.

These major categories provide a broad framework through which support may be granted for nearly any important aspect of marine resource development, including aspects not ordinarily funded through other sources, such as considerations of law, economics, sociology, and business and public administration. However, the primary purpose of the National Sea Grant Program is to advance the state of ocean technology through the application of science and engineering to problems of resource development, through dissemination of useful information, and through the training of professional and technical specialists.

Through existing academic institutions and research institutes, as many elements of the nation and of society as may be possible and appropriate will be involved to ensure that the Sea Grant Program is national in character. Consequently, geographic factors will be taken into account in both Sea Grant College and Sea Grant Project support awards. Public Law 89-688 stipulates that obligations made through grants or contracts to institutions in one state in any fiscal year under this program may not exceed 15 percent of the total amount appropriated for purposes of the Act in that year. The Law also specifies that the Great Lakes are a part of the marine environment. Inland institutions are eligible equally with those located near the sea or Great Lakes, but, in general, their marine-oriented capabilities are more limited.

An important objective of the Sea Grant Program is to stimulate new ideas and approaches. The nation's institutions of higher education have contributed substantially to imaginative and productive innovation in other fields of endeavor, and the Sea Grant Program is first and foremost a means of obtaining such contributions in the development of marine resources.

SPECIFIC CONSIDERATIONS APPLICABLE TO BOTH COLLEGE AND PROJECT GRANTS

Established National Science Foundation procedures and regulations will apply to both Sea Grant College support and Sea Grant Project support. These procedures and regulations are described in "Grants for Scientific Research," NSF Pamphlet 63-27, June, 1963. Sea Grant Proposals must commit the institution to cost sharing as required by the Act, which states that the grantee must provide at least one-third of the total cost required for an approved Sea Grant. Sea Grant Proposals must demonstrate the full commitment of responsible officials to a successful program and should include a well developed analysis of the potential of the proposed program for contributing to national and regional progress in marine resource development.

Sea Grant proposals should demonstrate a substantial existing competence and continuing programs in fields related to the proposal and to the objectives of the Act. The proposals further should detail the availability of adequate facilities for use in the project or program, including laboratories, ships, docks, or basic instrumentation. The facilities need not belong to the institution making the proposal; they may be available by lease or rental, or by agreement with State or local governments, industry, or another institution. Use of Federal Sea Grant funds for facilities is prohibited by the Act, which states: "No portion of any payment by the Foundation to any participant in any program to be carried out under this title shall be applied to the purchase or rental of any land or the rental, purchase, construction, preservation, or repair of any building, docks, or vessel." However, the Act also provides that, "for purposes of computing the amount of the total cost of any such program furnished by any participant in any fiscal year, the Foundation shall include in such computation an amount equal to the reasonable value of any buildings, facilities, equipment, supplies, or services provided by such participant with respect to such program (but not the cost or value of land or of Federal contributions)."

Weight will be given to cooperative efforts, which should be described in the proposal. The participation of industry in cooperation with institutions applying for Sea Grant support is strongly recommended when appropriate. One purpose of the Sea Grant Program is to foster interaction between the Federal, State, and local governments, and universities, laboratories, business, and industry in solving common problems by bringing diversified resources, facilities, and specialized competences to their solution.

Periodic progress reports will be required from all grantees. In addition, grantees will be expected to keep the Foundation informed promptly of significant accomplishments, or changes in operations. This is necessary because future planning will depend heavily on reports from grantees.

THE SEA GRANT COLLEGE PROGRAM

A Sea Grant College is envisioned as an institution engaged in a broad-based program that includes research, training and education, and advisory services related to development of marine resources within the meaning of the Act. Sea Grant College support will be given to a limited number of institutions which qualify competitively to carry out major programs in both training and research, and which have the capability to undertake marine advisory programs. Support will be provided by a single grant to each successful applicant. Continuing support may be furnished to achieve the objectives of the program where warranted by quality of performance. Sustained excellent performance under the program is required for official designation of the institution as a "Sea Grant College."

The Sea Grant College support program necessarily will be based in those institutions of higher education which have demonstrated capability for at least two years in the marine sciences and marine-related education, and which have the facilities and staff required for undertaking applied research, ocean engineering, training, and advisory activities. The required existing capability may be attained by cooperation among institutions acting together.

It is expected that institutions receiving Sea Grant College support will evolve into important information centers for strengthening marine utilization programs in their geographical regions. Although there undoubtedly will be initial problems in coordinating with existing regional and national advisory services which are supported by a wide range of private and government organizations at all levels, institutions submitting Sea Grant College support proposals will be expected to have thoroughly examined regional needs and capabilities including transportation, fisheries, mining, recreation, aquaculture, and both professional and technical training. In the selection of institutions to receive Sea Grant College support, considerable weight will be given to the institution's ability to serve its contiguous geographic region. The cooperation of State and local governments is most desirable.

Cooperative programs with technical schools, junior colleges, and secondary schools in the region will be encouraged. The grantee institution could serve as a resource through which smaller institutions without adequate staff or facilities can improve their capability.

Each Sea Grant College support applicant will supply statistical background information, names of faculty members involved, and their degrees, and a description of marine-oriented activities already Federally sponsored. Other necessary information will include the administrative structure of the institution, degree of provision of its own resources, past accomplishments in marine-related education, research and development, and estimated impact of the proposed Sea Grant on other activities in the region. A detailed description of how the program will be administered for maximum service to its region and the nation should be included in proposals.

SEA GRANT PROJECTS

Sea Grant Projects are individual projects designed to support a specific aspect of marine resource development. Projects may be directed to any aspect of marine resources, including education, training, research, or advisory services, including those previously described as elements of a Sea Grant College. It is expected that most Sea Grant Projects will be supported by a single grant for one or two years. Continuing support may be available for a reasonable length of time for projects of outstanding merit and promise.

The Sea Grant Project program is intended to start activities in as many useful fields of marine-oriented applied research and training as funds may allow. Although applied research and the training of engineers and technicians will be emphasized, some projects may be basic scientific studies in their entirety if the eventual application of results seems reasonably clear, and if funds cannot be obtained from other sources. Projects in the Social Sciences are included.

Whereas Sea Grant College support will concentrate funds in a few institutions, the Sea Grant Project program will spread funds more widely. It is expected that Sea Grant Projects will be a means of assisting some institutions to develop marine-oriented capabilities through activities directed to the more limited aspects of marine resource research and education.

CONCLUSION

The Sea Grant Program is new, and it is not possible or desirable to attempt too rigid definition of either College or Project support requirements. The Foundation expects to maintain flexibility in its approach to proposals and urges that interested institutions use both imagination and boldness in developing proposals. The purposes of the Act would not be fulfilled by a series of activities that serve only to continue and expand the things now being done to exploit the oceans.

A pamphlet containing suggestions for preparation of Sea Grant College and Sea Grant Project proposals will be available in a short time and will be sent on request.

The Foundation's Sea Grant Program staff is available for consultation. Institutions may address inquiries to:

Office of Sea Grant Programs
National Science Foundation
Washington, D. C. 20550

Leland J. Haworth

Leland J. Haworth
Director

Mr. Abel. At the same time the Science Foundation decided to implement the program through two main divisions. First, sea grant project support, in direct response to the act, was to include individual tasks either of research and development nature, education and training, or information transfer. The latter is broadly inclusive of advisory services, extension programs, et cetera. Thereafter, in August, the Science Foundation published the official brochure containing the guidelines for proposals and going into considerably more detail as to the scope of the program. I should like to offer that for the record as well at this time.

(The information follows:)

Suggestions for Submission of Proposals

NATIONAL SEA GRANT PROGRAM

To Aid in the Development of Marine Resources

NATIONAL SCIENCE FOUNDATION

NSF 67-18

SEPT. 1967

INTRODUCTION

On October 15, 1966, the President signed Public Law 89-688, the NATIONAL SEA GRANT COLLEGE AND PROGRAM ACT, for the purpose of accelerating national development of marine resources. The term "Sea Grant" was chosen to emphasize the parallel between the present need for ocean resource development and the need for development of the land at the time of the Morrill Act of 1862, which established the Land Grant Program. While the Sea Grant Program follows the pattern of the Land Grant Program only to a very limited extent, it does embrace the principal concept: that of providing a means through which scholars and institutions of higher education can apply their competence and knowledge to the practical needs of the nation and the world.

In accordance with this concept, the National Sea Grant College and Program Act assigns to the National Science Foundation the responsibility for supporting and encouraging the nation's institutions of higher education and other institutes, laboratories, and public and private agencies to play a major role in marine resource development.

The Act defines "development of marine resources" as endeavors related to the development, conservation, or economic utilization of the physical, chemical, biological, or geological resources of the marine environment. Included in the marine environment are the oceans and Great Lakes, the continental shelf of the United States, the seabed and subsoil of submarine areas adjacent to the coasts, and the seabed and subsoil of submarine areas adjacent to the coasts of islands comprising United States Territory.

The Act states that the Foundation shall exercise its authority under the Act by:

"(1) initiating and supporting programs at sea grant colleges and other suitable institutes, laboratories, and public or private agencies for the education of participants in the various fields relating to the development of marine resources;

(2) initiating and supporting necessary research programs in the various fields relating to the development of marine resources, with preference given to research aimed at practices, techniques, and design of equipment applicable to the development of marine resources and;

(3) encouraging and developing programs consisting of instruction, practical demonstrations, publications, and otherwise, by sea grant colleges and other suitable institutes, laboratories, and public or private agencies through marine advisory programs with the object of imparting useful information to persons currently employed or interested in the various fields related to the development of marine resources, the scientific community, and the general public."

For operational purposes, the National Sea Grant Program has established two distinct elements: **Sea Grant Institutional** support[1] and **Sea Grant Project** support.

Sea Grant Institutional support will be focused in institutions engaged in comprehensive marine resources programs that include research, education, and advisory services. Such institutions should provide leadership, and scientific and technological resources for marine activities within their regions.

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[1] In the Foundation's Important Announcement dated June 8, 1967, this type of support was referred to as "Sea Grant College Support." The appellation has been changed in order to avoid the implication that institutions other than educational ones are ineligible or any implication that an award of this type of support connotes designation as a Sea Grant College.

Sea Grant Project support has the purpose of aiding individual projects in marine resource development. In general, such projects will be single, well-defined, research, study, education, advisory, or training activities expected to produce information, techniques, methods, or systems applicable to marine resource exploitation. Many more institutions will receive Project support than Institutional support. Thus, a wide variety of institutions will have an opportunity to participate according to their interests and competence. Institutions will not necessarily be limited to a single Project grant.

While Sea Grant Institutional support and Sea Grant Project support have common objectives, criteria and scope of activities differ somewhat. Consequently, suggestions for preparing proposals for each program are treated separately in this brochure, and are followed by a section devoted to considerations and National Science Foundation regulations common to both types of support. No rigid format is prescribed for proposals, and it is expected that each proposing institution will use the suggestions according to the nature of the proposal.

Sea Grant College. The Act defines a "sea grant college" as an "institution of higher education supported pursuant to the purposes of this title which has major programs devoted to increasing our Nation's utilization of the world's marine resources." The Foundation will, from time to time, designate as Sea Grant Colleges institutions of higher education which have demonstrated sustained excellent performance along a broad front and have received some support under the Act.

SUGGESTIONS FOR PREPARATION OF PROPOSALS FOR SEA GRANT INSTITUTIONAL SUPPORT

Sea Grant Institutional support is intended to assist institutions of higher education which have broad-based competence and interest in ocean science and education to develop additional major programs devoted to increasing utilization of marine resources.

In fully developed form, activities under the Sea Grant Institutional Support Program should produce significant intellectual and practical impact on marine resource development in the institution's geographic region, and in the nation. The Sea Grant activity should be a stimulant and a source of technical assistance for State and local governments, industry, business, and other institutions within the institution's region. Activities supported under the program should produce essential manpower for marine resource development, new knowledge, and continuing innovations.

Activities under Sea Grant Institutional support may involve any schools or departments of the university or college which could be useful in achieving Sea Grant objectives in addition to schools or departments engaged in activities commonly associated with the marine environment. For example, a school of law could study the legal aspects of marine resource development; a medical school could study various aspects of the physiology and human engineering of marine resource recovery techniques; a school of pharmacy could develop programs in the field of marine pharmacology; a department of journalism could contribute to advisory services; a home economics department could improve home utilization of marine foods and provide advisory services most useful to homemakers; and schools or departments of business administration, economics, sociology, psychology and political science could study marine resource development in terms of their disciplines or specialities.

It is not expected that all institutions receiving Sea Grant Institutional support will develop activities of so broad a scope; most will develop programs of a size dictated by their interests and ability, and the requirements of the geographic regions they serve. In all cases, however, institutions participating in the Institutional Support Program should be leaders and unifying forces within their regions in all matters of marine resources development which they undertake. Institutions are not required to establish a subordinate special entity for Sea Grant purposes if existing organizational arrangements are adequate.

CRITERIA FOR SEA GRANT INSTITUTIONAL SUPPORT APPLICANTS

Any suitable institution may apply for Sea Grant Institutional support. Criteria on which awards will be based include the following:

—A history of significant marine-related activities in research and education, and demonstrable success of those activities.

—Availability of the necessary facilities for conduct of the Sea Grant Program, including laboratories, ships, docks, etc.

—A capacity and an intention to adopt the Sea Grant Program as a major goal, as demonstrated among other things, by the full commitment of responsible senior officials to the program.

—A staff recognized in the marine community for leadership and scholarship.

—Ability to match the Federal contribution by providing at least one-third of the cost of Sea Grant activities.

—Capacity for growth, and the ability to plan and execute a complex program of high quality.

DEVELOPING A SEA GRANT INSTITUTIONAL SUPPORT PROGRAM

In general terms, the proposal should present the concept, profile, and plans of the proposed Sea Grant Program and the base on which it is to be created by the applicant institution. Suggested specific elements are as follows:

Title Page

No specific format is required. However, the title page should identify the institution, the responsible subdivision of the institution, and principal responsible officials including the chief executive officer of the institution and the director or coordinator of the proposed Sea Grant activities. Complete mailing addresses, telephone numbers, and social security numbers should be included for all individuals. The proposed first-year contribution from the Foundation should be given.

Opening Summary

An opening summary should describe the institution's proposed activities under the Sea Grant Program and present a well-developed analysis of its potential for contributing to regional and national marine resource development. The method used in estimating the potential should be described briefly. The institution's major programs related to marine resources should be summarized.

The Sea Grant Plan

A five-year plan for the proposed Sea Grant program should be given in sufficient detail to permit evaluation of the total projected program and its major elements. The plan should start with the present base and show the phasing in of additional elements by years. The elements of the plan should be selected from and described under the following categories, as pertinent:

1. **Education and Training.** Plans and curricula for graduate, undergraduate, and technical training should be described, with estimates of the number of entering students and probable numbers and types of certificates or degrees to be awarded. The roles of any participating institutions should be defined. For example, some universities may prefer to arrange for conduct of two-year technical training programs through nearby institutions with existing capability. If on-the-job training or practical experience through industry cooperation are part of the training plan, arrangements should be described.
2. **Research.** The general plan for research should be detailed, showing fields of activity. Initial studies and initial research projects should be described fully. For each project or related group of projects a brief abstract and statement of objectives should be given, together with a description of previous work done in the project field at both the applicant institution and elsewhere. Proposed starting dates and estimated duration should be noted. Principal investigators should be identified by name, address, telephone number, and social security number. Professional qualifications should be given for each.
3. **Advisory Services.** The general plan for organization and operation of advisory and demonstration services should be outlined, with specific information on contemplated demonstration plans and extension service activities. Cooperative arrangements, if any, should be described.

The Region to be Served

The region to be served by the Sea Grant activities should be described and a map included showing political divisions and locations of principal installations and facilities of marine interest. Appendices should detail population information, other public or private institutions and facilities in the region with marine-related programs, marine resource-related businesses and industries and their nature, and such statistics as may be available on regional productivity and utility of marine resources.

Description of the Institution

A brief history of the applicant institution should be included, with a listing of major contributions within the past five years to research and education in marine science or technology.

Information should be covered under the following headings:

1. Academic base of the Sea Grant plan; present organization and current programs in marine-related fields.
2. Leadership of the institution, including the leadership of departments or schools

involved in the five-year plan, and the chief executive or coordinator of the proposed Sea Grant activities, giving names, titles, social security numbers, degrees of participation in man months per year, academic backgrounds, and significant accomplishments.

3. Administrative base of the proposed Sea Grant activities, including proposed changes in administrative structure, if any. Information on the institution's rate of growth should be included, with details of other Federal support related to marine science, technology, and education.
4. If cooperation has been arranged with other institutions, institutes, or laboratories, the cooperative arrangements should be summarized with a description of the cooperating entity, including leadership, ongoing marine-related programs, and other Federal support being received for marine-related activities.
5. If support is to be received for the proposed activity from State or local governments through provision of facilities, services, or finances, details should be given. Cooperating State or local facilities or agencies should be described briefly.
6. Plans and arrangements for participation by industries, businesses, associations, and other private entities should be covered. Copies of letters of intent, memoranda of agreement, etc., should be appended.

Facilities for a Sea Grant Institutional Support Program

Pertinent facilities available to the institution should be described briefly, noting their adequacy to meet requirements of the Sea Grant plan. Proposed facility expansion or addition should be given, including sources of funding or supply.

Budget Information

Costs should be shown for administration, education and training, research and development, and advisory services. The customary breakdowns by salaries, travel, supplies, equipment, and operations should be detailed. Contributions by the institution totalling at least one-third of the cost should be described, including sources, to cover the requirements of the Act. (Please refer to the General Considerations, page 8.)

Supplementary Information

Any information pertinent to the Sea Grant plan or the institution, but not covered under other headings, should be given, including information on faculty not described elsewhere, data on student populations in participating schools and departments, degrees awarded at each level, expressions of support and interest from organizations not mentioned elsewhere in the proposal, consultants being utilized in the planning and/or execution phases, and makeup of coordinating groups on marine resources of which the institution is a member.

CONSULTATION

The full scope and orientation of the Sea Grant Program concept should be developed by each proposing institution on the basis of practical considerations of institutional interest and competence and the needs of the region to be served. The Foundation's Office of Sea Grant Programs is prepared to consult with prospective proposers, especially during the formative stages of proposal development.

PLANNING GRANTS

It is recognized that in some cases plans for Sea Grant Programs will entail considerable expense, especially in those cases where the regional or cooperative aspects of the plan require preliminary studies or regional conferences in order to develop background data. In such cases the Foundation will be willing to consider preliminary requests and to award a limited number of modest planning grants to help support such preliminary activities. Proposals for planning grants should follow the general format described above insofar as possible. Contributions by the institution totalling at least one-third of the cost of the planning activities will be required in accordance with the requirements of the Act. (Please refer to the General Considerations, page 8.)

SUGGESTIONS FOR PREPARATION OF PROPOSALS FOR SEA GRANT PROJECTS

Sea Grant Projects are individual projects related to marine resource development, conducted by qualified institutions or organizations, and considered separately from Sea Grant Institutional support. Sea Grant Projects generally will be directed to clearly defined objectives with potential for contribution to marine resource development.

Sea Grant Project grants will be awarded for one or two years. Projects of unusual merit and promise, or of continuing value, may qualify for renewal of support.

Project proposals will be considered in any of the major categories defined by the Sea Grant College and Program Act: i.e., training and education, research, and advisory services.

The number of project support awards within a given fiscal year will depend on funds available. Because of the necessity for maintaining reasonable balance among the various fields of marine resource development, the number of projects and amount of resources already allocated in the same general field will be a consideration.

CRITERIA FOR SEA GRANT PROJECT SUPPORT APPLICANTS

Public or private institutions of higher education, and suitable institutes, laboratories, and public or private agencies may be eligible for Sea Grant Project support.

Criteria on which awards will be based include the following:

- —The merit of the project and its potential for contributing to objectives of the National Sea Grant Program.
- —The proposing institution's demonstrable competence and experience in the project field, or in a closely related field requiring approximately the same competence and experience.
- —The full commitment of responsible officials of the institution to a well-managed project.
- —The qualifications of the Principal Investigator (in the case of a research project) or of the Program Manager (in the case of an education or advisory project).
- —Availability of the necessary facilities for conduct of the project.
- —Ability to provide at least one-third of the project cost (see General Considerations, page 8).

DEVELOPING A SEA GRANT PROJECT PROPOSAL

The proposal should be sufficiently detailed to permit evaluation of its merit, and of the ability of the proposing institution and the Principal Investigator or Program Manager to achieve its objectives.

Title Page

No specific format is required; however, the title page should identify the proposal as a "Sea Grant Project" and give the title of the proposed project. The cover page should include the name and address of the institution, the responsible school or department of the institution if applicable; and the name, title, signature, social security number, and telephone number of both a senior institutional representative able to commit the institution, and the Principal Investigator or Program Manager. Proposed starting date and duration, and the amount requested from the Foundation should be included.

Summary

An opening summary (an abstract in the case of a research project) should describe the project, its objective, and the method of operation.

Description of the Project

The project should be described in sufficient detail to permit evaluation of its merits, including pertinent background, how the project relates to national needs, and the expected contribution to marine resource development. Work of a similar nature conducted at the proposing institution or elsewhere should be referenced, and a bibliography of such work included, if pertinent. If the proposal is for an educational or advisory service project, its relationship to similar projects in the state or region should be described. If it is for a research project, its relationship to other pertinent research in the United States and abroad should be stated. The operational plan should be described. Future developments should be anticipated to the extent possible; e.g., growth should be projected for training projects if appropriate; possible development of research projects into future pilot or demonstration projects should be noted, etc.

Project Leadership

Pertinent details of the background of all principal project personnel should be provided, starting with the Principal Investigator or Program Manager. Degrees, experience, and appropriate publications should be given. If cooperation with industry, business, state or local facilities, or other institutions is part of the plan, similar information on key personnel who will be involved in project operations should be given. The amount of time to be devoted to the project by each individual should be noted.

Facilities Available

The facilities available for the project should be listed, noting their source and adequacy to meet project objectives.

Budget

Details of how the Foundation's grant would be used should be given covering salaries, fringe benefits, equipment, supplies, travel, publication costs, indirect costs, and any other costs. The reasonable value of the institution's contribution (not less than one-third of the total project cost) should be detailed.

The National Sea Grant Program does not at present include fellowships or scholarships; however, assistantships of various kinds necessary for conduct of the project are allowable.

Other Information

Any elements of the institution pertinent to the project should be described. For example, if a project in aquaculture is based on the experience and competence of an agricultural engineering department, a description of the department should be included. If the project is in technician training, other technical training activities in the institution should be summarized, with information on numbers of entering students, degrees or certificates granted during the past five years, faculty strength, and any other details that will give a profile of the institution. For an advisory service project, details of institutional competence and experience in similar or related fields should be noted.

Agreements with cooperating entities should be described in terms of the entity's contribution to the project. Letters of intent, memoranda of understanding, and similar documents should be appended.

Other marine-related activities funded from Federal sources at the institution should be listed.

Annual reports, pertinent publications, etc., may be included in the appendix.

CONSULTATION

Qualified institutions interested in Sea Grant Projects are invited to begin with an inquiry to the Foundation's Office of Sea Grant Programs to establish the appropriateness of the project for Sea Grant support. The Sea Grant staff is prepared to work closely with interested institutions in the initial phases of proposal preparation.

GENERAL CONSIDERATIONS APPLICABLE TO BOTH SEA GRANT INSTITUTIONAL AND SEA GRANT PROJECT SUPPORT PROPOSALS

1. Established National Science Foundation procedures and regulations will apply to the National Sea Grant Program. Principal elements are given in item 9 in this section and further details are available in National Science Foundation Pamphlet 63-27, June, 1963, "Grants for Scientific Research," which will be furnished on request.

2. **Geographic Factors.** An intent of the National Sea Grant College and Program Act is to involve as many sections of the nation as feasible in Sea Grant marine resource development activities; therefore, geographic factors will be considered in awards for both Sea Grant Institutional support and Sea Grant Project support. Proximity to seashore and ocean access, while clearly enhancing pursuit of certain types of marine research, will not be requisite to participation in the Sea Grant Program. In accordance with the Act, obligations made through grants or contracts to institutions in one state in any fiscal year under this program may not exceed 15 percent of the total amount appropriated to the Foundation for purposes of the Act in that year.

3. **Cooperative Efforts.** Institutions submitting proposals are encouraged to undertake cooperative programs with other institutions, with business and industry, with State and local governments, and with Federal laboratories.

4. **Emphasis on Applied Activities.** Because the primary purpose of the National Sea Grant College and Program Act is development of marine resources and engineering, activities funded under the program generally should be directed to applications. Although applied research and the training of engineers and technicians will be emphasized, some activities may be basic scientific studies in their entirety if the eventual application of results seems reasonably clear. Legal, economic, sociological, business administration, home economics and similar studies important to marine resource development or utilization are considered to be applied research.

5. **Need for Innovation.** Imagination and innovation are desired in Sea Grant activities. The intent of the Act would not be fulfilled by strict adherence to traditional approaches in resource development. The nation's academic institutions have contributed substantially to imaginative and productive innovation in other fields of endeavor, and it is expected that this tradition will be maintained in the development of marine resources.

6. **Reporting Requirements.** In addition to the administrative reporting required under Foundation accounting procedures, substantive reports will be required from all institutions receiving Sea Grant support. Reports will be required annually and at the end of the support period. Reports will include statements of progress toward the initial goal, changes in goals made necessary by developments, accomplishments within Sea Grant support, or the contribution of Sea Grant support to goal accomplishment. Respecting education programs, reports should discuss student populations, graduations, and job acquisition. Because the future course of the National Sea Grant Program will be determined to a large extent by feedback from grantees, interim reports will be expected as important results (both positive and negative) are obtained.

7. **Matching Costs.** The National Sea Grant Program is a matching program under which the grantee institution must provide at least one-third of the cost. The Act specifies that "the total amount of payments in any fiscal year under any grant to or contract with any participant in any program to be carried out by such participant under this title shall not exceed $66^2/_3$ per centum of the total cost of such program. For purposes of computing the amount of the total cost of any such program furnished by any participant in any fiscal year, the Foun-

dation shall include in such computation an amount equal to the reasonable value of any buildings, facilities, equipment, supplies or services provided by such participant with respect to such program (but not the cost or value of land or of Federal contributions)." The total cost of such program includes the sum of the allowable direct costs incident to performance, plus the allocable portion of the allowable indirect costs of the participant, less applicable credits. Allowability and allocability of costs will be determined in accordance with Bureau of the Budget Circular No. A-21 (Revised) for educational institutions, or Subpart 1-15.2 of the Federal Procurement Regulations for other than educational institutions. In determining the "reasonable value of any buildings, facilities, equipment, supplies or services provided," the following criteria apply.

For buildings and facilities, allowable costs of educational institutions may be based upon a reasonable use charge, taking into account the proportionate use of the building or facility for Sea Grant purposes, in accordance with BOB Circular No. A-21 (Revised). For permanent equipment, allowable costs likewise may be based upon a reasonable use charge in accordance with BOB Circular No. A-21 (Revised); accordingly, the cost of permanent equipment purchased with the institution's own funds may not be charged to the project as a direct cost at the time of acquisition. Permanent equipment is defined as equipment having a useful life in excess of one year and acquisition cost of $500 or more, unless the institution's established policy for capitalizing equipment provides for a different dollar amount. Equipment necessary to a Sea Grant activity may be purchased with grant funds subject to prior approval by the Foundation. In unusual cases involving equipment, the Foundation is prepared to consult with the institution on the best procedures to be followed. If buildings, facilities, or permanent equipment were acquired in whole or in part with Federal funds, the use charges must be reduced in proportion to the Federal contribution. The costs of expendable equipment (having a useful life of one year or less) and supplies required for performance of the project are allowable either as direct costs or indirect costs, in accordance with consistently applied principles of accounting. The kinds of services may include, but are not limited to, such items as personal services, professional services, travel, insurance and indemnification, recruitment, and communications. The cost of services required for the performance of the project are allowable as either direct costs or indirect costs, in accordance with consistently applied principles of accounting.

Cost-sharing requirements for these programs may be satisfied by the recipient institution with a contribution from any source other than the Federal Government to any of the cost elements of the project, direct or indirect.

Since it will be necessary to demonstrate that cost sharing is fulfilled, institutions must maintain accounting records which will establish their contributions. Records must be maintained to show, as required by the Act, that charges to the Foundation grant or contract *in any fiscal year* did not exceed 66²/₃ percent of the total cost of the program in that fiscal year. If the expenditures are less than originally contemplated, the relationship between the institution's contribution and the total cost should remain essentially the same as proposed in the approved application or in a subsequent approved revision.

8. **Restrictions on Grant Fund Use.** Sea Grant funds contributed by the Federal government may not be applied to the purchase or rental of any land, or the rental, purchase, construction, preservation, or repair of any building, vessel, or dock. This restriction does not, of course, apply to the use charges assignable as part of the grantee contribution.

9. **Principal NSF Regulations and Procedures.** The principal Foundation regulations and procedures applicable to the National Sea Grant Program are summarized below for convenience in preparing proposals. Institutions and organizations with previous experience in obtaining and administering Foundation grants and contracts already will be familiar with NSF requirements; those preparing proposals to the Foundation for the first time are urged to familiarize themselves with the standard regulations and procedures described in NSF 63-27, "Grants for Scientific Research," and by direct consultation with the Foundation should questions arise.

(a) *Current support and pending applications* —The Foundation must be informed of the total research effort of each principal investigator or program manager listed in the proposal. Information concerning *all* of the public and private, current and anticipated support of the principal investigator or program manager and other senior personnel participating in the proposed activity must be provided. Current support refers to *all* support; whether for the proposed activity or any other activity. Anticipated or possible support refers to all requests which are currently pending and requests which the individual plans to submit in the near future. The statement provided should include, when known, the titles and dates of current grants or contracts including identification numbers, the source of the funds, the annual budgets (total with direct costs indicated in parentheses), and the proportion of the effort devoted to each activity by the individual involved.

(b) *Familiarity with grantee's responsibilities*—If a grant is awarded and accepted, it must be administered in accordance with certain conditions, policies, and practices required by the Foundation. In particular, the proposal should contain a statement that the endorsers are familiar with and will accept the conditions, policies, or practices described in the following items, (1) through (3):

(1) *Title VI of the Civil Rights Act of 1964*—This title states that no person in the United States shall, on the grounds of race, creed, color or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under, any program or activity receiving Federal financial assistance. To implement this requirement the Foundation issued a regulation that all grantees must submit or have on file an "Assurance of Compliance with Title VI of the Civil Rights Act of 1964." The Foundation's Grants office will supply on request the Assurance of Compliance forms and a copy of the regulations. When an institution completes and submits to the Foundation an Assurance form, this covers all proposals subsequently submitted by that institution. A condition for awarding a grant is that the grantee affirms that the "Assurance of Compliance with National Science Foundation regulation under Title VI of the Civil Rights Act of 1964" has been executed and fully applicable to the grant to be awarded.

(2) *Water pollution control*—Executive Order 11288 dated July 2, 1966, establishes Federal policies, procedures and standards relative to water pollution prevention, control and abatement. This order includes the requirement that pollution caused by activities or programs supported in whole or in part by grant funds must be reduced to the lowest level practicable. It is the grantee institution's responsibility to comply with the Federal standards.

(3) *Laboratory animal welfare*—P.L. 89-544 dated August 24, 1966, and the Federal Register Volume 32, number 37, Part II, dated February 24, 1967, establish regulations and standards for dealers and research facilities handling dogs, cats, non-human primates, guinea pigs, hamsters or rabbits. These requirements are concerned with handling, care and treatment of animals during holding and transportation, not during actual research or experimentation. It is the grantee institution's responsibility to comply with these standards as applicable.

(c) *Patents and inventions*—The grantee is responsible for informing the Foundation of any invention made or conceived by the principal investigator or other person working on a grant supported project. The Foundation has the right of determining whether or not, and where, a patent application should be filed, and the disposition of the invention and title to and rights under any application or patent that may result. The Foundation in making these decisions, takes into account the public interest and the equities of the grantee.

(d) *Foundation liability*—The Foundation assumes no responsibility for accidents, illnesses or other losses suffered while engaged in Foundation supported research.

(e) *Grant revocation*—The Foundation may revoke a grant in whole or in part if it is determined in consultation with the grantee that the research cannot be carried out or the conditions set forth in the grant letter cannot be adhered to. When a grant is to be revoked the institution will reduce, insofar as possible, the amount of outstanding commitments and report the amount of the uncommitted balance to the Foundation. The grantee must submit a final fiscal report on the revoked grant.

(f) *Safeguarding of funds* — Advances of money received from the Foundation must be deposited in the checking accounts maintained by the grantee. In no case will the funds so advanced be commingled with the personal funds of any of the officers of the grantee institution, organization, or society, nor will any of the funds be deposited in personal bank accounts for disbursement by personal checks.

WHERE, WHEN, AND HOW TO SUBMIT PROPOSALS

Proposals for both Sea Grant Project and Sea Grant Institutional Support will be received at any time. However, considerable time is necessary for review and processing of proposals, and the following schedule is offered as a guide:

proposals should be submitted by:	**for funds needed in:**
January	June-July
April	September-October
September	January-February

Preliminary or draft proposals sent to the Foundation as a basis for comment or discussion during the initial preparation phase should be addressed to the *Office of Sea Grant Programs*. Five copies of such "discussion drafts" should be sent.

Proposals in final form sent to the Foundation for official action should be marked "Sea Grant Proposal" and addressed to:

National Science Foundation
Washington, D. C. 20550

Twenty copies of proposals will be required. Preliminary inquiries should be addressed to:

Office of Sea Grant Programs
National Science Foundation
Washington, D. C. 20550

Telephone: Area Code 202 343–8673

Mr. Abel. Until that time obviously proposals had to be discouraged as a matter of fairness. Proposals are now coming in. They are currently in review. To properly evaluate these proposals the Science Foundation is in the process of convening two panels. The first panel will consider proposals for sea-grant project support. Again, owing to the extremely broad scope of the act, covering as it does the basic sciences pertaining to oceanography, for example, marine biology, chemical oceanography, et cetera, also encompassing the applied nature of the ocean development itself, for example, fisheries, offshore mining, aquatic recreation, et cetera, and concerning specifically the imposition of the social sciences for example, economics, law of the sea, et cetera, we will find that this panel will be extremely large, perhaps as many as 100 persons. Naturally this panel will probably never meet in its entirety.

Rather, when proposals are submitted to the Science Foundation, it is our current intention to select from this broad panel individual task teams according to their individual areas of expertise. The second panel will be somewhat more formal in nature. It will consider proposals for sea grant institutional support. In this category would be included the schools coming in for support under all phases of the act, including research and development, education and training and the advisory services. This panel, as presently designed, would include nine persons, drawn about equally from industry, and from the academic world, with a fair geographic representation since the act itself is clearly oriented to local and regional problems. Finally, the members of this panel would include several areas of expertise—the sciences and the various applications. Since you are after all the authors of this bill, I have skipped rather simply over the mechanics of its implementation and naturally will be happly to answer any questions on the subject. However, I would like to discuss a few of the issues which have emerged coincident with the bill's development and the implementation of the act.

First of all, while this act is one of the broader mandates handed by the Congress to the executive branch of the Government, concerning as it does the entire spectrum from basic research to advanced engineering and development, for good reason the Science Foundation has elected to emphasize the applied research sector of that R. & D. spectrum. First, it was evident as the sense of Congress from the hearings, from the reports, that this was the intent of the act, the major thrust.

Secondly, we would prefer not to compete with the other sections in the National Science Foundation, with the Office of Naval Research, and with several other Federal agencies who already sponsor basic research.

This would also be true of the educational phases of the act. We propose to emphasize education for engineers and training of ocean technicians.

The second point which emerged immediately concerns the interface between the National Science Foundation and other Federal agencies who have missions in the public service concerned with ocean development.

For instance, the question could be asked: Where does the role of the Bureau of Commercial Fisheries leave off and the role of sea grant begin?

It was just as clear that it would be an extremely difficult task to try as a formal procedure to formulate guidelines by which the proposals would be automatically determined as whether they were within the purview of one agency or another. We have elected to use a much more informal arrangement. Accordingly, the Science Foundation has conferred with the hierarchies of the rest of these bureaus, specifically, for instance, Assistant Secretary Cain in Interior, Dr. White in Commerce who appeared before me this morning, and Secretary Frosch's office in the Navy.

It was agreeable to all concerned that the approach might as well be informal. When a proposal is received, which could conceivably lie within that gray area of jurisdiction, it is simply a matter of contacting the proper person in the agency and asking, "How do you consider this proposal? Is it within your purview? Would you suspect it might be in mine?"

So far we have encountered no trouble whatsoever. Naturally, we are taking advantage of the gradual emergence of interagency coordination as developed by the Interagency Committee on Oceanography; thus the contacts already exist for this purpose.

The next point I would like to make concerns the tremendous interest aroused by the passage of this act. This interest has been aroused in industry, the academic world, State governments, and private foundations.

It has caused, either directly or indirectly, the formation of interdepartmental alliances, intercollegiate consortia, and interstate contacts for the purpose of more effective exploitation of the ocean environment and specifically often including prosecution of sea-grant programs.

Needless to say, this has been extremely encouraging.

We have compiled a list by States of the number of schools who have already asked us for information from which they could prepare proposals for sea-grant support. With your permission I would like to submit that for the record as well.

(The information follows:)

SEA GRANT PROGRAM CONTACT WITH COLLEGES[1]

State	Number of colleges	Number of junior colleges	Total
Alabama	6	1	7
Alaska	7	1	8
Arizona	1	0	1
Arkansas	4	0	4
California	55	5	60
Colorado	5	2	7
Connecticut	9	0	9
Delaware	2	0	2
District of Columbia	5	0	5
Florida	13	6	19
Georgia	4	0	4
Hawaii	2	0	2
Illinois	6	0	6
Indiana	4	0	4
Iowa	3	0	3
Kansas	1	0	1
Kentucky	1	0	1
Louisiana	10	0	10
Maine	3	0	3
Maryland	2	0	2
Massachusetts	7	1	8
Michigan	6	0	6
Minnesota	3	0	3
Mississippi	4	0	4
Missouri	2	0	2
Nebraska	1	0	1
Nevada	2	0	2
New Hampshire	2	0	2
New Jersey	5	0	5
New York	30	0	30
North Carolina	6	0	6
North Dakota	1	0	1
Ohio	7	0	7
Oklahoma	2	0	2
Oregon	4	0	4
Pennsylvania	11	0	11
Rhode Island	1	0	1
South Carolina	2	0	2
Tennessee	3	0	3
Texas	9	0	9
Utah	1	0	1
Vermont	2	0	2
Virginia	7	0	7
Washington	9	0	9
West Virginia	1	0	1
Wisconsin	5	0	5
Total	276	16	292
Possessions:			
Guam	1	0	1
Puerto Rico	2	0	2
Virgin Islands	1	0	1
Total	4	0	4
Foreign contacts:			
Chile	1	0	1
India	1	0	1
Italy	1	0	1
Total	3	0	3

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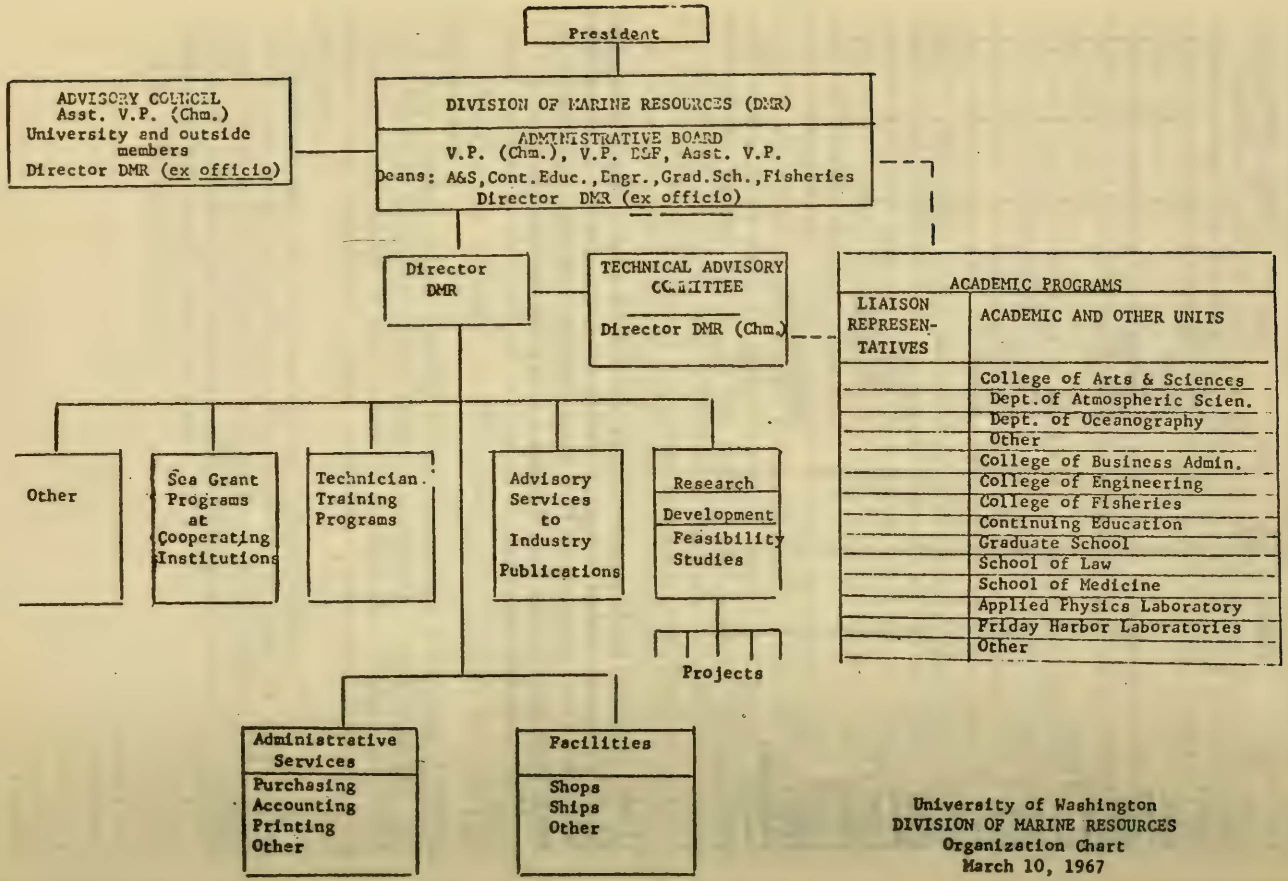
[1] Mail, personal contacts, telephone inquiries to the NSF Office of Sea Grant Programs.

Mr. ABEL. In addition, several of the institutions proposing support have prepared rather unusual tables of organization to cope with sea-grant-type programs. We have samples of these available and with your permission would submit a typical one for the record.

(The material follows:)


President
ADVISORY COUNCIL
Asst. V.P. (Chm.)
University and outside members
Director DMR (ex officio)
DIVISION OF MARINE RESOURCES (DMR)
ADMINISTRATIVE BOARD
V.P. (Chm.), V.P. B&F, Asst. V.P.
Deans: A&S, Cont.Educ., Engr., Grad.Sch., Fisheries
Director DMR (ex officio)
Director DMR
TECHNICAL ADVISORY COMMITTEE
Director DMR (Chm.)
ACADEMIC PROGRAMS
LIAISON REPRESENTATIVES
ACADEMIC AND OTHER UNITS
College of Arts & Sciences
Dept. of Atmospheric Scien.
Dept. of Oceanography
Other
College of Business Admin.
College of Engineering
College of Fisheries
Continuing Education
Graduate School
School of Law
School of Medicine
Applied Physics Laboratory
Friday Harbor Laboratories
Other
Other
Sea Grant Programs at Cooperating Institutions
Technician Training Programs
Advisory Services to Industry
Publications
Research
Development
Feasibility Studies
Projects
Administrative Services
Purchasing
Accounting
Printing
Other
Facilities
Shops
Ships
Other

University of Washington
DIVISION OF MARINE RESOURCES
Organization Chart
March 10, 1967

Mr. Abel. I would like to discuss the fiscal nature of the program very briefly. As you know, the Science Foundation was permitted to reprogram $1 million of its own funds for this purpose from 1967 funds which were carried over for fiscal year 1968. The budget for the fiscal year 1968 program as submitted by the President was $4 million for the program. It is too early in the fiscal year 1969 cycle to predict what the level of support will be.

As has been explained in previous hearings, the Science Foundation does expect that the program could, all things being equal, rise within the next 4 or 5 years to perhaps $20 or $25 million. As you know far better than I, this depends on far too many national and international factors to try to predict with any accuracy now.

The last issue I would like to raise concerns broadly the Nation's view of this young program. It is apparent from the correspondence and the attention that we have received already that Sea-Grant implies to some a panacea to solve all of the problems associated with the development of our oceans. That in turn, judging from the acclaim often given to our Nation's ocean program, may be expected to cure all ills of humanity. This is not to be, gentlemen. I would emphasize that payoff from research and development in the oceans must be considered in very, very long-range context. This does very definitely apply to the Sea-Grant concept as well.

In considering the future of this program, my natural optimism as its manager has to be tempered by experience and knowledge of the essential nature of the ocean itself. I would not under any circumstances want to mislead you into looking for payoff from the Sea-Grant program for at least the next couple of years. In fact, realism dictates that really significant payoff is at least a decade in the future. Of course, we are looking for some useful results well before that time, particularly including the emergence of highly trained manpower.

As you know, you have given us a double-barreled program, not only with the objectives of exploitation per se, but also permission and the wherewithal to build the resources, including trained manpower from which to conduct these exploitation programs. Therefore, our initial objectives will concern mainly the building up of these resources from which we are going to accomplish practical exploitation of the seas later on. It is something to which the Sea-Grant concept is admirably suited. It is a goal which we personally approach with considerable enthusiasm.

Ever since the program's inception I have been deluged with demands from all sectors of the marine science community, highlighting above all else a desperate need for ocean technicians; that is, persons competent to go to sea, make observations at sea, to keep the apparatus running and repair it as necessary, to take the data and at least initially process these data and do similar things in the shoreside labs. This is a prime mission to which we in the Sea-Grant Program are already committing ourselves and hopefully we would predict significant output of such technicians in 3 or 4 years.

In conclusion, I think it is desirable to point out that the potential effect of this program has already been signaled by the enthusiastic response we have already received. You have created a rather great weapon for this exploitation.

The mechanism is distinguished by large scope and extreme flexibility. So that from this point I would say that realization of that potential is up to us now and the only promise that I can make to you at this time, is that we will certainly do our best.

Thank you very much, Mr. Chairman. I will be happy to try to answer any questions.

Mr. DOWNING. Thank you very much, Mr. Abel.

Mr. Lennon.

Mr. LENNON. Mr. Abel, last week the Vice Chairman of the Presidential Commission appointed under Public Law 89–454, who incidentally is president of Texas A. & M., appeared before the committee with the Chairman of the Presidential Commission. The Vice Chairman stated that in his considered judgment there was a need for, in round figures, 3,000 so-called marine technicians or some who had been exposed at least, on an annual basis right now, not 2 or 3 years from now. I noticed you have attached as part of your prepared statement a letter that I assumed was directed to the presidents of universities and colleges, so it states, dated June 8, 1967. Subject: National Sea-Grant Program.

That is a general, broad analysis of the program as you view it in the future. I assume that it was sent out to the presidents of the universities and colleges in the United States?

Mr. ABEL. Yes, sir. To the best of our knowledge, it went to the president of every university, every college, every junior college and community college in the United States.

Mr. LENNON. Including technical institutes?

Mr. ABEL. Yes, sir. Wherever we knew about them. For this purpose we borrowed the lists of the Association of Junior Colleges, Association of Technical Institutes, and society mailing lists.

Mr. LENNON. I notice attached to and made part of your prepared statement what I assume was the number of colleges in each of the States, and those junior colleges which I assume would include the publicly supported technical institutes. You categorize them as junior colleges, but does that list that you have there include the technical institutes supported by public tax dollars?

Mr. ABEL. Yes, sir. Wherever we knew about them.

Mr. LENNON. I suppose that when you say Sea-Grant Program contacted colleges, that you had actual contacts or responses from those colleges and junior colleges listed State by State?

Mr. ABEL. Yes, Mr. Lennon. Every college that we have listed has come to us with at least a letter or personal contact asking for information from which they may prepare proposals later for sea-grant support.

Mr. LENNON. I do not mean to be provincial but in the consideration of this legislation there developed in the judgment of some of us the need for this program in our so-called technical institutes who had a program oriented to the marine sciences.

I got into that picture and was one of the ones who insisted on this language.

I am a little bit surprised to see from the list of those that currently responded, no response from the technical institutes in my State. They are actively engaged in this field with their own vessels and so forth, and I know they are interested in this program.

They did not respond. I just have my serious doubts about that.

Mr. Abel. Mr. Lennon, are you referring to the Cape Fear Technical Institute, by chance?

Mr. Lennon. Yes.

Mr. Abel. They were given a copy of the announcement.

Mr. Lennon. Back in June?

Mr. Abel. Yes, sir.

Mr. Lennon. You have not heard from them?

Mr. Abel. No, sir. I have had previous correspondence and personal contacts, as a matter of fact, with that institute. I can only suggest that they may be biding their time and waiting for the issuance of the brochure. Several colleges have done this to our personal knowledge. I wanted to be conservative in making up the table. In other words, if I received a phone call from someone—not in this particular case—simply saying, "Don't worry about us; we are coming in later but we want to see the brochure first to save effort," then I did not include them because the list was already growing with such tremendous rapidity that I was really afraid of the impression it might create, almost a national hysteria.

You see, Cape Fear is a school well known to me. As a matter of fact, I was instrumental 3 years ago in placing one of their graduating students.

Mr. Lennon. I might comment the Nation's oceanographers made a personal visit down there and recruited some of their graduates for their naval oceanographic program here. I did not mean to interrupt. Go ahead.

This leads me to the quandary that you found yourself in with respect to the overwhelming response that you have from 55 colleges in California that have asked to participate in this program already which is indicative of some of the large coastal States as well as substantial inland States where we have no coastlines.

Are you thinking in terms of ultimate block grants to the school in order that a class could be offered or program could be offered to every potential interested young person in this program? Are you thinking in terms of those people only as individuals who go to these institutions and who have an inclination or concern and a desire to get into this field, that you would help them financially in order that they could pursue this scholastic undertaking?

If you are going to every one of these total of some 292 colleges that you have heard from already, with a block grant, to make it possible for them to have a teacher just to teach one or more classes, this authorization is too meager even for the first year.

I believe the authorization for the first fiscal year was $5 million and $15 million for each subsequent fiscal year under the terms of this act. I think that $5 million of the President's budget was provided for, as I recall your statement, and then there was $1 million that you were permitted to carry over above the program.

You now have for fiscal year 1968, assuming the appropriation bill is passed or will pass with this $4 million, you will have $5 million. Are you thinking in terms, Dr. Abel, you and your associates, of going into these round figures of 300 colleges with a program to everybody who wants to attend class, or are you thinking in terms of picking out those young people who have already demonstrated an interest to make it possible for them to continue their academic work in this field in that particular college or institute?

Mr. MOSHER. Would the gentleman yield?

Mr. LENNON. Yes, sir.

Mr. MOSHER. I would like to add to your question.

Mr. LENNON. Make a mental note of that, Dr. Abel.

Mr. MOSHER. This is completely related. I am also interested in whether you are funneling this money toward institutions that already have competence and perhaps excellence in the field, or whether you are funneling it in part, or what part, toward institutions that have no ready competence but are anxious to begin to acquire competence.

I think this is related.

Mr. ABEL. Mr. Lennon, with your permission I would like to answer Mr. Mosher's part of the question first because there is a natural lead into yours.

Mr. LENNON. Go ahead.

Mr. ABEL. Mr. Mosher, as you gentlemen know far better than I, the theory of Federal aid is bivalent. Sometimes the two concepts are not completely compatible. For example, it is naturally desirable when one wants to get a job done to go where the power is, where the facilities and the talents are the greatest.

At the same time, there is certainly a natural desire to place aid where aid is most needed. Clearly, you will not always find a situation where you can find the second within the first. So we had thought of approaching the problem in the following manner.

Sea-grant institutional support connotes a very broad attack on the ocean in all phases of the act as you have designed it. Therefore, its provisions would have to be met by institutions with traditional strengths and with the facilities to carry out all phases of the act. In fact, we have so designated clearly in the brochure itself. We have stated that one of the criteria under which proposals will be evaluated must concern a traditional excellence in these fields. This leaves us project money to be placed within institutions who may not really have much more to offer than promise backed up by a clearly evident commitment to do their very best, to develop talents which they may possess in large part but which have not gone on the record, so to speak.

We hope that by careful application and blending of these two modes of support, that we can satisfy both concepts of Federal aid. Now, to proceed specifically to Mr. Lennon's question——

Mr. LENNON. Before we get into my specific question, having answered his, just for the record let me quote from Public Law 89–688, so-called Sea Grant Colleges Act, of the National Sea Grant College Program Act of 1966, from subsection (c) of section 204.

I think this is important in line with what you said. We have discussed this in depth in committee hearing and particularly in the Congress. It was written in conference, this language was written in conference:

> Programs to carry out the purposes of this title shall be accomplished through contracts with or grants to suitable public or private institutions of higher education, institutes, laboratories, and public or private agencies which are engaged in or concerned with activities in the various fields related to the development of marine resources for the establishment and operation by them of such programs.

How do you interpret that language?

Mr. Abel. I interpret it in this way: It is a matter of degree. We will not be giving support—I would state this clearly—we will not be giving support to institutions with no previous experience or capability. What I was referring to are small institutions, or perhaps large institutions somewhat recently established in the field, which have indicated the desirability to them at least of enhancing the resources which they possess.

There are several dozen of these included in the contact list which I have submitted for the record. I have seen this grow personally, as have all of you, from a list when this—your own subcommittee—was formed of perhaps a dozen institutions of sizable nature offering degrees, and perhaps another 20 of the kinds of institutions I am referring to now, simply with one or two miscellaneous programs in ocean sciences and perhaps offering fragmented curriculums. This has grown now to an aggregate of about 100 of such schools, at least two dozen of which offer organized degree curriculums and the rest somewhere in the rest of the spectrum.

Mr. Lennon. Mr. Abel, you recognize we will get the most for the tax dollar and fulfill the hope of the Vice Chairman of the Presidential Commission who expressed the intense desire that we encourage those young people who are already oriented and attending institutions, colleges, universities, and laboratories, which already have a marine program and need financial help to produce the people we need in this program.

That is the point I wanted to get over. If we proliferate $5 million to all these schools, some of which I question how they would ever get interested in the marine sciences segment, we would not get maximum results from the available money, we are looking to people who can move in this thing as quickly as possible.

Mr. Abel. You are entirely right, Mr. Lennon. I want to assure you that none of the schools in the category that you have mentioned have received any encouragement from the Foundation beyond the issuance of that official announcement which as a matter of policy must go to all schools.

Mr. Lennon. Does the authorization under the law that we are discussing permit assistance through a loan or a grant to a young man, say, who has had 2 years in a college or university in this specialized field and needs a little financial assistance in the way of a loan or grant to complete his academic career in this program?

Are you limited to making grants to institutions, colleges as such?

Mr. Abel. I would like to make one philosophical comment and ask Mr. Maechling to give you an interpretation of the act in depth for the Foundation.

Mr. Lennon. Yes.

Mr. Abel. The thing is, that as you have expressed yourself, funds are rather meager for this program, to say the least.

It is going to be difficult enough to apply these funds in a concentrated manner to face the need for "critical mass." As Dr. White said this morning, this kind of work is very, very expensive. There will not be too much left over for peripheral activities. As a matter of policy, for the time being, we have indicated in our brochure that scholarship and fellowship assistance would not be available. Assistantships would.

Do you want to speak to that, Mr. Maechling?

Mr. MAECHLING. I think the only thing that I could add to that, Mr. Congressman, is that under the rather broad authority granted by the act there does not seem to be much doubt legally that it is quite possible to give this type of grant or scholarship to individuals. However, I believe the policy of the Foundation has been to include such support under or within the sphere of an established project or program.

Mr. LENNON. That leads me to ask, under the legal definition for the purpose of this title we define a sea-grant college and say, " * * * which has major programs devoted to increasing our Nation's utilization of the world's marine resources."

You find that under subsection 3 of the same title, section 204 on page 3 of the act.

There again I am strengthened by my belief that it was the congressional intent in getting this program off the ground that we should confine ourselves to those colleges, universities, and institutes which already had major programs. If I read the terms and definition, it specifically and rather definitively describes a grantee as a sea-grant college which has a major program devoted to increasing our Nation's utilization program. Then the act goes on to define the term "sea-grant program."

That also is rather limited to those institutions which are already engaged in the development of marine resources, and so fourth. I think we are in agreement on this because the demand that is coming in already, as you have said, necessitates that this act be tightly followed during its first 2 or 3 years, even if funding were not a problem, which it is.

I think we have to run a pretty tight ship on this thing under the language and intent of Congress under the act. I think you agree with me on that?

Mr. ABEL. I would more than agree with you on that, Mr. Lennon. Without that particular kind of statement and differentiating factor, I frankly would not know how to begin the screening process.

Mr. LENNON. So far this act is only effective as regards funding in the fiscal year. It was funded for the fiscal year ending June 30 of next year, fiscal year 1968. Have there actually been any grants?

Mr. ABEL. No, sir.

Mr. LENNON. What appropriation bill did this come under—the independent offices?

Mr. ABEL. Yes, sir.

Mr. LENNON. The House has passed the independent offices appropriation bill. They have not passed that in the Senate yet?

Mr. ABEL. As I understand it, it is——

Mr. LENNON. It may have.

Mr. ABEL. There was some action during this week while I was out of town. Dr. Robertson might know about it.

Dr. ROBERTSON. I believe it passed the Senate the day before yesterday and will go to conference.

Mr. LENNON. So far as you recollect, the $4 million in the President's budget was included both in the House action and in the Senate action; is that your information, gentlemen?

Dr. ROBERTSON. That is my understanding, yes, sir.

Mr. LENNON. That being so, then there is no question about what the conferees will do. That means you will have $5 million for fiscal year 1968.

That is all. Thank you, Mr. Chairman.

Mr. DOWNING. Mr. Mosher?

Mr. MOSHER. Mr. Abel, in the act, in defining "marine environment," we were careful to include the Great Lakes area. I assume that I am correct that institutions in the Midwest, far, far from the oceans, adjacent to the Great Lakes area, are being given equal consideration, assuming they meet the other qualifications; is that true?

Mr. ABEL. Yes, sir. Historically, inland institutions have participated in the national oceanographic program in the following fashions: First of all, they have offered courses more on the theoretical than the empirical side, that is, discussing the oceans in the abstract, perhaps mathematically.

Several institutions have taken this road. In fact, I believe Lehigh issued a report about 5 years ago called "Conducting Oceanography at an Inland College." In another way, a college may specialize in the ocean-atmosphere interface, with emphasis on the atmosphere, as at the University of Wisconsin with its rather splendid meteorology program. A third way would concern the Great Lakes. A fourth can concern the use of adjacent water areas as experimental tanks or models of the ocean itself.

In this way there are several inland institutions which have built up excellent reputations, if not in oceanography in its pure sense at least in the category called marine science and technology.

Mr. LENNON. I have no further questions.

Mr. DOWNING. Mr. Pelly.

Mr. PELLY. I would like to find out whether I was misinformed about the institutions in my district. I gave a talk to a junior college where they have a course in training technicians for oceanography. I told them I thought it was quite important. I notice that you listed no contacts in the State of Washington indicating that no interest has been shown. I am sure there is. Yet, on the other hand there are nine contacts from colleges. I was not quite sure we had nine colleges in our State. Is there any chance that there is a combining of the junior colleges along with others? Would the nine include junior colleges?

Mr. ABEL. Mr. Pelly, to answer your question specifically, that is exactly what is contemplated in Seattle. I spent the last 2 days in Seattle, arriving at 6 o'clock this morning from there. What they want to do is to establish liaisons between, say, the University of Washington—as the master organization—with the satellite institutions, thereby offering peripheral courses or—for instance, technician training programs, since some of them already are proficient in such curriculums.

Mr. PELLY. That makes sense to me.

Mr. ABEL. It has been a very happy situation all the way around. Several States are doing this. The University of Washington was, to the best of my knowledge, the first to come and tell us they were doing this. Of course, they had a natural situation with three community colleges in the immediate area.

Mr. Pelly. I noticed in our sister State of Alaska that there are seven. I did not know there were seven colleges in Alaska.

Mr. Pollock. I wanted to ask about that.

Mr. Pelly. I yield the floor.

Mr. Pollock. Maybe you can respond.

Mr. Abel. Mr. Pollock, they are all branches of the same school—the University of Alaska in Juneau, Sitka, et cetera. The whole State of Alaska has always been—naturally enough—ocean conscious. This consciousness was, to say the least, catalyzed and encouraged by the Vice President's recent visit of 2 months ago. He took rather considerable pride in explaining to a group about 2 weeks afterward that he had managed to render the whole State atingle; we are quite conscious of this from correspondence.

Mr. Pelly. I have one further question. Are any land-grant colleges, for example, in Iowa prospective recipients of assistance? I remember one of our colleagues from Iowa expressed concern when this legislation was considered that assistance would only go to coastal States and none to such areas as Iowa. I think he was told that land-grant colleges could apply and qualify.

Mr. Abel. Mr. Pelly, any college may apply. Mr. Lennon has really explained the situation far better than I could. While I would not want to prejudge any college without having received their proposal and understood their existing facilities, it must be obvious that there are some States who have traditionally not been concerned at all with the oceans. An attempted invasion of our $5 million by them at this time would be perhaps a little premature.

Mr. Pelly. I agree with Mr. Lennon. We have a need for 3,000 personnel in this field—is that right?

Mr. Lennon. That is right.

Mr. Abel. Technicians.

Mr. Pelly. It is not going to take too many institutions to fill that need.

Mr. Abel. That is right. We have been approached already by between three and four dozen such institutions who have been offering technician training courses. Here you see a curious situation because very few, as Mr. Lennon knows, with the exception of those in perhaps Maine, North Carolina and three or four other States, have specifically oriented their technician training to the ocean. At the same time, several really outstanding schools who have trained technicians not necessarily directed toward ocean exploration would like to participate.

In some cases they would like to participate as satellites of a major university which has a strong interest in the ocean.

Mr. Pelly. I feel very encouraged by your report today. I think you are proceeding in a way that leads me to believe that those of us who were enthusiastic about this legislation are going to be very gratified.

Mr. Abel. Thank you very much.

Mr. Pelly. That is all.

Mr. Downing. Mr. Reinecke.

Mr. Reinecke. Thank you, Mr. Chairman.

I would like to apologize for being tardy. I was testifying before the Foreign Affairs Committee on the Maltese resolution. I am happy to say to other members of the committee and the witness there is a great deal of activity and interest there. There was full attendance on the committee. It was very encouraging.

I am happy also to see California so big in the column in your recap sheet or table.

I do not have any specific questions. I think they have been covered by, you might say, the rest of the members of the committee.

Probably one of the reasons California did come through in such grand style is that the Governor of the State has a very active committee in a program he has called GACOR, Governor's Advisory Committee on Ocean Resources. This is a very active group that has generated a great deal of interest throughout the State, probably to the frustration of some, judging by the number here. Nonetheless, I am glad to see the general approach you have taken on this program. I am sure that this committee will speak on your behalf when it comes to appropriations. We will see that you do get funding for the future.

I think this businesslike approach is very commendable.

Mr. Abel. Thank you very much, sir. I have taken the liberty of approaching the GACOR for some help which I am sure you will understand is needed in handling the California situation. Consequently, in 3 weeks I will meet with them in order to draw up such indices that might be feasible to differentiate and to screen and allow us a logical selection process.

Mr. Downing. Mr. Pollock.

Mr. Pollock. Thank you, Mr. Chairman.

I wanted to pursue the comments of Mr. Lennon.

As I understand the utilization of these funds, your institutional grants will go where you have the established institutions now. I presume that is what you were saying. You will have some project support grants going to areas where hopefully there is potential development. Is that correct?

Mr. Abel. That is correct, Mr. Pollock. We very clearly would insist on orienting institutional grants to the situations where the expertise is already available. To combine these two theses for a moment, when we are considering the allocation of project money sometimes it is not immediately discernible that there may be a pocket of expertise in a school that you would not think would be interested. For instance, at Ohio State, which is somewhat far removed from the ocean, there exists extraordinary expertise in law of the sea. As you remember, your act in addition to enhancing the natural sciences, also brings in the social sciences. Here we cannot necessarily be limited to the coastal institutions traditionally involved with oceanography. Some of our best economics professorial talent and some of our best legal talent are in the inland university systems.

Mr. Pollock. One other question, Mr. Abel.

Do I understand that the emphasis on the technician training by and large will be in the community colleges?

Mr. Abel. Not necessarily by definition. It is just that there have been more community colleges who have approached us than the senior colleges. I think this is probably owing to the tradition of junior colleges who have so long emphasized courses of this character. In some cases without any previous experience in this area they have come in with surprisingly good plans indicating quite a bit of home-work and some worthwhile contact with professional marine science personnel.

Mr. POLLOCK. I would like to say that I am as enthusiastic about this whole program as I am sure you are. Certainly my colleagues on the committee will be not only watching it closely but working with you at every possible opportunity.

Mr. ABEL. Thank you.

Mr. POLLOCK. Thank you, Mr. Chairman.

Mr. DOWNING. I wonder if you would clear up something for me. You testified how this money is to be allocated with one panel on projects and one panel on institutions.

Mr. ABEL. Yes, sir.

Mr. DOWNING. Would you define what projects are?

Mr. ABEL. Yes, sir. There will be three categories of projects. Those proposing support for applied research in areas dealing with recovery of ocean resources. They may generally include the areas of aquaculture, aquatic recreation technology, and the technological features of ocean mining, short of the province of the Bureau of Mines, of course. They will include proposals featuring curricula for educating engineers in ocean engineering and training technicians for oceangoing activities.

The third category in which projects will be proposed will concern the traditional information transfer projects, such as extension courses and advisory services.

I think Dr. Spilhaus dramatically portrayed these as seagoing county agents, paralleling the land-grant system.

Mr. DOWNING. Are these projects tied up with educational institutions of some kind?

Mr. ABEL. Yes, sir.

Mr. DOWNING. It would not involve private projects?

Mr. ABEL. It can, theoretically, within the limitations of the act, but in practice, during the formative stages of the program I do not think we would be wise in trying to spread our funds to cover private enterpises. However, we very definitely encourage alliances between institutions and profitmaking enterprises to the extent that the institution may use the facilities and expertise of these industrial firms.

Mr. DOWNING. It seems to me that you would have to be awfully careful not to dissipate your money on projects when the educational aspects of it is thus.

Mr. ABEL. Most of the projects themselves will be educational in nature.

Mr. DOWNING. I know of one private company which has gone into oceanography as a sideline in a big way. They are on the verge of extracting minerals from the sea. They need Federal help at this point to go on. Conceivably that could be a project. Certainly it would be educational. It is a private concern.

Mr. ABEL. Yes, sir.

In a case like this, I would refer as much as possible to the sense of Congress, and guided by the hearings and reports issued by your subcommittee and by your opposite number in the Senater it simply seems to me that the main thrust of your argument—toward what you are orienting this act, is to the institutional type of activity. I am open to correction.

Mr. Lennon. Will the gentleman yield?

Mr. Downing. Yes.

Mr. Lennon. Due to the difference between a profit and a nonprofit corporation. Certainly you do not intend to help on projects for a concern whose principal admitted motivation is profit, but where it is a nonprofit corporation related to the marine sciences you could make grants for programs. Is that your differentiation?

Mr. Abel. Yes, sir.

Mr. Downing. Even they would have to be very carefully defined and gone into, would they not?

Mr. Abel. That is true.

I believe, sir, I would be somewhat naive if I ignored the ramifications here, some of the possibilities of funding a nonprofit establishment which could in a way, as you know, compete with profitmaking establishments. These are very hazy areas and it is hard to design a doctrine to cover all such cases before examining the proposals themselves.

Mr. Downing. Thank you.

Mr. Lennon. While we have had a most interesting and informative and helpful statement by Mr. Abel, I would like to ask unanimous consent that following his statement and his colloquy with the members there be included in the record his full written statement which covers some things we were not able to cover here as I went through it rather hurriedly.

Mr. Downing. Without objection, it will be placed in the record.

Mr. Abel. Thank you.

Mr. Lennon. Mr. Abel, I do not understand that the failure of an institution or an institute or college or university to respond to the letter that went out to them on June 8 of his year means that these who have responded have automatically established priorities on programs in any way?

Mr. Abel. No, sir; not in the slightest.

Mr. Lennon. You subsequently, as I understand, intend to send out brochures to the wide spectrum of everybody that is covered under the act?

Mr. Abel. We have issued these to everyone who received the announcement.

Mr. Lennon. When did that go out?

Mr. Abel. That went out August 30, sir.

Mr. Lennon. One other question.

In the backup material which I think ought to be included as part of his statement—and I ask unanimous consent that it may be part of the permanent record—I notice on figure 12 which is found on page identified as page 69, you have Sea Grants Training, a three-dimension pattern, and I believe I understand law, economics, politics, administration, chemistry, biology, physics, geology, recreation, mining, fisheries, and defense, but right down through the center of it you have the word "politics."

I think I know the connotation. My distinguished colleague, Mr. Downing, and I have been exchanging views about it.

Are you talking about international politics or domestic politics, or are you talking about authorizations by the Congress and budgetary problems and appropriations by the Congress?

Mr. Abel. At this point, Mr. Lennon, I would like to run for cover and allude to the authorship of the document as the Marine Council. However, I am quite sure the context you see the word "politics" in refers more to political science and therefore oceanography's place in international affairs.

Mr. Lennon. I think we had better stop right there.

Mr. Downing. Mr. Rogers, do you have questions?

Mr. Rogers. I am very much concerned about really moving this program.

When do you think we can expect to have a full sea-grant college program operating?

Mr. Abel. First let me preface my remarks, Mr. Rogers, by saying I can speak for the Foundation, and Dr. Robertson can bear me out here. The Foundation views this as a very, very important program; the implications are awfully far reaching. The program, therefore, has been designed with consummate care. We have not wanted to be overhasty about issuing these documents in order that they be as comprehensive as possible and as clear as possible at the same time.

We are now in position to receive proposals, and indeed proposals are coming in. Sea-grant project support can be allocated relatively simply. Sea-grant institutional support is another matter. The proposals we are receiving are page-numbered in the hundreds and in some cases over a thousand. This is a difficult proposition to evaluate because, as the author of the act, you know that the scope is broad, and it is complicated. We must evaluate in the same arena, proposals for law of the sea development, economic considerations, basic science considerations, submarine biology and submarine geology, and all their applications, and in no case to my knowledge have any of these institutions been shy in approaching these applications. They are all concerned for this problem we call multiple use of the sea.

So there is tremendous balance necessary in evaluating fisheries as opposed, for instance, to mining development as opposed, for instance, to aquatic recreational use of the shoreline.

These considerations make it rather difficult to evaluate these proposals. We have selected our panelists with care. We would hope the selection of the panel will be complete and our invitations accepted in about 2 weeks, at which time I would like to submit to you a list of the panel membership. They have the responsibility of evaluating our own screening of the proposals, and from that point we must make the decision.

I would hope that at least the first of these decisions would be made, if not by the end of this year, at least very early next calendar year. Judging from the very careful manner in which some of these proposals have been prepared, I would prefer not to put myself on record sa predicting a definite schedule.

Mr. Rogers. You mean you do not know when your first grants will go out?

Mr. Abel. No, I cannot predict this accurately.

As I say, I would hope that we could do this by the end of the year. I would not want to make a guarantee to that effect. The proposals that we have received for institutional support are tremendously complicated, Mr. Rogers.

Mr. ROGERS. I understand the institutional support will be more complicated than your sea-grant project; is that correct?

Mr. ABEL. Yes, sir.

Mr. ROGERS. When will your project grants be ready to go?

Mr. ABEL. I would hope we would have made decisions on the first project grants within about a month.

Mr. ROGERS. So at least that part of the program will be ongoing within a couple of months' time, at least as far as decisions being made.

Mr. ABEL. Within my best prediction, yes, sir.

Mr. ROGERS. But the institutional program will not really get going until next year and probably not until September of next year because the colleges probably would not be cranked into it until the next 2 years?

Mr. ABEL. With respect to the academic year all of the colleges are flexibly geared so they can start certain phases of their program as soon as they receive a grant.

Mr. ROGERS. Second semester or something like that?

Mr. ABEL. Yes.

Mr. ROGERS. How many students do you anticipate this program will cover?

Mr. ABEL. It is going to depend on the relative allocations of training support, applied research support, and advisory services support; certainly there will be no fewer than a couple of hundred students supported under this program.

Mr. ROGERS. Thank you very much. We will be anxious to follow this program very closely.

Mr. KEITH. Several times in your statement you mention that the Sea-Grant Program will serve as a catalyst. I would like to go into that aspect of the program a little. You stated that your Office would not be able to fund all useful projects that will be proposed. Do you have any plans to publicize these worthy but unfunded projects so that interested organizations which are in a position to fund these projects might become acquainted with them? I'm thinking of organizations like the Ford Foundation and even business firms.

Mr. ABEL. By "catalyst" I refer to the possibility of this program's furnishing funds to start a project which in its inception might be beyond the desire or jurisdiction of another agency to sponsor but which could be acceptable in later, more highly developed phases. The word "catalyst" also refers to the possible emergence of Sea-Grant-supported institutions as local and regional centers. These centers, in turn, would influence further ocean development by other organizations in their respective localities.

The most important catalytic effect of the Sea-Grant Program has already occurred, however. Several departments have joined forces in preparing Sea-Grant proposals; consortia have been arranged between schools; and internal and outside advisory groups have been convened. Thus, without spending a cent, the sea-grant concept has enhanced communications in the academic community.

While the periodic reports which we will be making to you will include the publications of worthy but unfunded projects, we would not be content to stop with this rather passive technique in handling such projects. Already, wherever appropriate, I have taken advantage of my former ICO affiliations; the Sea-Grant staff has contacted personnel elsewhere within the foundation and within the other related Federal agencies to determine possibilities of joint sponsorship of projects wherever appropriate. While no such arrangements have yet been consummated, we have not found any organization opposed to such arrangements in principle.

While we have not specifically approached the Ford Foundation or any business firms in this regard, any listings which we would prepare for the public domain would be given appropriate circulation. Of course, we would list only those institutions giving us permission to include them. It is conceivable that some institutions would not want publicized the fact of their rejection, for whatever reason.

Mr. KEITH. Several of the research programs conducted by Government agencies are in fact, contracted out, at least in part, to universities. Do you feel that it would be advantageous for your office to play a significant role in the process in light of the fact that your Office will soon acquire a considerable amount of information about the educaional institutions that are likely to be concerned?

Mr. ABEL. During my employment with the Interagency Committee on Oceanography, we acquired quite a bit of information concerning educational institutions. We were able to form this information into several useful services and products, including publications numbers 8, "Opportunities in Oceanography," 19, "Scientific Manpower in Oceanography," and 23, "University Curricula in Oceanography," among others. More importantly, we learned that several Federal agencies can contribute in similar fashion.

I would view our current role in the same light, namely, that while the Sea-Grant Office could play a significant role in enhancing Government/university relationships, it would in no way become a dominant one. Rather, we would cooperate with other divisions in the National Science Foundation and with agencies elsewhere in Government.

Mr. KEITH. It appears to me that the line between an institutional grant and a project could be a very fine line. For example, a law school that qualified for institutional grant applies for a grant to a journal devoted to the legal aspects of marine activities. This grant could possibly be administered under either division of the program. What criteria other than the form which the request is addressed to your Office do you apply in determining under which division of the program the particular grant will be made?

Mr. ABEL. To answer the question directly, Mr. Keith, the Sea-Grant Office, which acts as jury in determining whether a proposal is more appropriately submitted for institutional or project support, utilizes the following criteria:

(*a*) Is the proposal addressed to one, two, or three sectors of Sea-Grant coverage, that is, R. & D., education and training, and/or information transfer?

(*b*) Does the proposal reflect the aspirations of a single department or the university itself?

(*c*) Do the plans as presented encompass the type and breadth of effort that could eventually typify a "Sea-Grant College?"

Other issues could perhaps be considered within the scope of this question. For instance, an institution applying for Sea-Grant institutional support might desire to commence one of the component projects as quickly as possible. In such instances we might suggest that the project be proposed separately, with the understanding that should the university in question ultimately qualify for institutional support, this project would be automatically encompassed.

Mr. Keith. That is all, Mr. Chairman. Thank you.

Mr. Downing. Thank you very much, gentlemen. Your statements have been informative and reassuring to this committee. If there are no further witnesses, the committee will adjourn.

(Whereupon, at 12:35 p.m., the subcommittee adjourned to reconvene Thursday, October 12, 1967.)

NATIONAL MARINE SCIENCES PROGRAM

THURSDAY, OCTOBER 12, 1967

House of Representatives,
Subcommittee on Oceanography of the
Committee on Merchant Marine and Fisheries,
Washington, D.C.

The subcommittee met, at 10:19 a.m. in room 1334, Longworth House Office Building, Hon. Alton Lennon (chairman of the subcommittee) presiding.

Mr. Lennon. The subcommittee will come to order. This meeting, gentlemen, is a continuation of our series of informational hearings to receive testimony from the various departments of Government and the agencies concerned with the national oceanographic program.

Our witness this morning is well known to many of us, Dr. Robert A. Frosch, Assistant Secretary of the Navy for Research and Development. Dr. Frosch is a very able and distinguished successor to two able and distinguished predecessors, Dr. Robert Morse and Dr. James Wakelin, with whom we have had the privilege and pleasure of working since the Interagency Committee on Oceanography was created in 1959.

For the record, Dr. Frosch is chairman of the Interagency Committee on Marine Research, Education, and Facilities, which is in effect the successor to the Interagency Committee on Oceanography. This is his first appearance before this subcommittee, but he is well known to most of us. We are delighted to have him with us today. We now look forward to a most valuable contribution to our present survey of the activities in the national oceanographic program.

Dr. Frosch, do you have a prepared statement?

Dr. Frosch. Mr. Chairman, I do not. I have some prepared material that I have made available to the committee.

Mr. Lennon. Fine. We have that. If you will just proceed.

STATEMENT OF DR. ROBERT A. FROSCH, ASSISTANT SECRETARY OF THE NAVY FOR RESEARCH AND DEVELOPMENT, AND CHAIRMAN, INTERAGENCY COMMITTEE ON MARINE RESEARCH, EDUCATION, AND FACILITIES, ACCOMPANIED BY CAPT. J. EDWARD SNYDER, JR., SPECIAL ASSISTANT, AND DR. EDWIN B. SHYKIND, EXECUTIVE SECRETARY, ICMREF

Dr. Frosch. Thank you very much, Mr. Chairman. It is a great pleasure and honor for me to meet with you for the first time, particularly because this committee has taken the broadest view of marine affairs of any group in the House of Representatives and has been responsible for so much action in this field.

I am here today really wearing two hats, I believe: One as Chairman of the committee to which you referred, and one in my statutory position as Assistant Secretary of the Navy for Research and Development in which position I am the senior official to whom has been delegated by the Secretary of the Navy the responsibility for the Navy's oceanographic program for the Secretariat.

As you are aware from previous testimony by Dr. Wenk particularly, the Interagency Committee on Oceanography was formally reconstituted on the 13th of July by the direction of the Vice President with the agreement of Dr. Hornig, the President's science adviser, and became the Interagency Committee on Marine Research, Education, and Facilities, with responsibility in the areas of basic research, engineering support not specifically connected with particular missions, manpower, education and across-the-board facilities.

I would like to speak first wearing the hat of the chairman of that committee to give you a general overview of the Federal establishment in those areas and the way in which the various departments and agencies divide their responsibilities, and to provide you with some information on the size of the Nation's supporting scientific establishment that does the work.

Then perhaps I might say a few words about the place of the Navy's program, putting on my Navy hat.

We have been able to continue and to begin reorganizing as a new committee easily because we are the successor to the ICO and we have been able to carry forward the staff support that we had with the ICO.

I have with me today Dr. Edwin Shykind, on my left, who is the executive secretary of this new committee and who was the staff director for the ICO.

You have before you a set of charts and we have large-scale versions of the charts for presentation. In some cases it will be easier for you to refer to the small ones and in some cases to the larger ones. Some of these charts have a good deal of information on them. I will not in the time available be able to speak to all of the information, but I think you might be able to find many details that will interest you when you have an opportunity to look at some of the charts with somewhat more time.

We thought we would start by showing you the national objectives as they have been stated: By the President's Scientific Advisory Committee in its report of June 1966, by President Johnson himself, in February 1966, and by Public Law 89-454, in which your committee played so large a role and which established the Council and the Commission. (See chart 1.)

CHART 1

NATIONAL OBJECTIVES

". . . Effective use of the sea by man for all purposes currently considered for the terrestrial environment: commerce; industry, recreation, and settlement; as well as for knowledge and understanding." PSAC June 1966

"To comprehend the world ocean, its boundaries, its properties, and its processes, and to exploit this comprehension in the public interest, in enhancement of our security, our culture, our international posture, and our economic growth." President Johnson, February 1966

> ". . . Develop, encourage, and maintain a coordinated, comprehensive, and long-range national program in marine science for the benefit of mankind to assist in protection of health and property, enhancement of commerce, transportation, and national security, rehabilitation of our commercial fisheries, and increased utilization of these and other resources." PL 89–454 June 1966

I think you can read these quotations rather than my reading them to you. They will say essentially the same thing, and, to my mind, we have very clear guidance from the President and from the Congress as to what the national objectives and the overall purpose of our national program in this field are to be.

I would now like to discuss the 10 agencies that are principally responsible for work in this area that I am talking about. They are listed on chart 2.

CHART 2

TEN AGENCIES

Defense
Commerce
Interior
National Science Foundation
Atomic Energy Commission
Health, Education, and Welfare
Transportation
Smithsonian Institution
State
National Aeronautics and Space Administration

I will go through the list agency by agency, explaining in each case what the responsibilities of each are in the marine science field with some comments on the subportions of the agency or department which are principally responsible.

We may begin with the Department of Defense which, of course, has primary responsibility for national security. The Department of Defense, has carried a large load in the development of undersea technology and was cited in the Council's initiatives, published in February of 1967, as having a major responsibility for undersea technology, at least until such time as other final organizational arrangements can be made based upon the reports of the Council and the Commission.

By statute, the Department of Defense also has certain civilian responsibilities, principally centering in the Army Corps of Engineers, listed on the chart. ARPA, which is the Advanced Research Projects Agency, is listed because, in connection with its responsibility for nuclear test detection matters, it has undertaken some undersea technology connected with seismology. (See chart 3.)

CHART 3

DEPARTMENT OF DEFENSE

National Security
Undersea Technology
Statutory Civilian Responsibilities
    Great Lakes, River, Harbor, Coastal, and Ocean Charting
    Great Lakes, River, Harbor, Coastal Restoration and Preservation

Navy
Army Corps of Engineers
ARPA

The next chart deals with the Department of the Interior, and the mission is, I think, clearly stated.

The various portions of the Department have responsibilities related to their overall missions. The Bureau of Land Management, Outdoor Recreation, and the Park Service have responsibility for various aspects of the use of the shoreline and ocean areas for recreation purposes. The other responsibilities, I think, are clear from the nature of the subportions of the Department. (See chart 4.)

CHART 4

DEPARTMENT OF THE INTERIOR

Management and Regulation of Ocean Resources
Measurement and Enforcement of Pollution Standards
  Geological Survey
  Federal Water Pollution Control Administration
  Bureau of Commercial Fisheries
  Bureau of Sport Fisheries and Wildlife
  Bureau of Mines
  Bureau of Land Management
  Bureau of Outdoor Recreation
  National Park Service
  Office of Saline Water

The National Science Foundation has responsibility both for the support of basic science and for certain educational support, particularly that connected with graduate and undergraduate training in the marine sciences. And, NSF is, of course, responsible for administering the new Sea-Grant college program. (See chart 5.)

CHART 5

NATIONAL SCIENCE FOUNDATION

Basic and Academic Oceanography
Graduate and Undergraduate Training in Marine Science
Sea-Grant College Program

The Department of Commerce has particular responsibility for problems in environmental prediction. In the Coast and Geodetic Survey, it has responsibility primarily for coastal charting and charting around the continental United States, its territories, islands, and possessions. In the Maritime Administration, of course, there is responsibility for improvement of the marine transportation system of the United States. (See chart 6.)

CHART 6

DEPARTMENT OF COMMERCE

Environmental Prediction
Charting Coastal and Deep-Ocean Waters
Central Responsibility for Air/Sea Interaction Program
Maritime Transportation System
Environmental Science Services Administration.
Maritime Administration.

In the general area under consideration today, the Department of Transportation has primary responsibility for safety at sea, delineation and prediction of ice masses, and support as required for various scientific and technological programs of other agencies. The Coast

Guard is, of course, the Department's principal operating agent in these fields. (See chart 7.)

CHART 7

DEPARTMENT OF TRANSPORTATION

Safety at Sea
Delineation and Prediction of Ice Masses
Support of other Agency Scientific and Technological Programs

U.S. Coast Guard.

The Atomic Energy Commission has a dual role: One, meeting the problems posed by radioactivity and the use of radioactivity in the marine environment, the safety requirements that go with that, and the particular problems that have to do with questions of disposal of radioactive materials. It also has a responsibility for the use and development of nuclear technology where it can be applied to general marine uses, including its use as a power source. (See chart 8.)

CHART 8

ATOMIC ENERGY COMMISSION

Effects of Radioactivity—Marine Environment
Development of Oceanographic Nuclear Technology

The Department of Health, Education, and Welfare has responsibility for keeping track of marine organism matters insofar as they affect health and pollution. You will note this is the second time the subject of pollution appears; the first was in conjunction with the Department of Interior. This is not in any sense a duplication. I think the division of responsibility is simply that Health, Education, and Welfare is responsible for the scientific aspects and characteristics of the organisms and the health considerations posed by the pollutants, while the Department of Interior is responsible for the overall problem of keeping track of pollution and the oceanographic phenomena that bear upon pollution.

In a real sense the portions of the Interior Department which are responsible for pollution look to Health, Education, and Welfare for fundamental knowledge about the organisms and the health effects that they must bear in mind.

As part of its overall mission in education Health, Education, and Welfare also has a responsibility for general education and for fellowships and grants in education which, of course, include some areas that bear upon education in marine sciences. (See chart 9.)

CHART 9

HEALTH, EDUCATION, AND WELFARE

Marine Organisms
    Health
    Pollution
Oceanographic Education
    Fellowships
    Grants

Public Health Service,
Office of Education.

The Smithsonian Institution has a particular responsibility for marine biology, involving the collection and investigation of marine organisms and populations from a general zoological point of view. The Smithsonian maintains the national collections, and they are important to our national understanding of the taxonomy and the ecology of the kinds of organisms in the populations in the sea. (See chart 10.)

CHART 10

SMITHSONIAN INSTITUTION

Investigation of Marine Populations

The State Department, of course, is responsible for our foreign affairs in this field, as in others, and particularly for the U.S. participation in various international programs, which include the support of the various international fisheries commissions dealing with the management of the world's fish and marine resources. (See chart 11.)

CHART 11

STATE DEPARTMENT

United States' Participation in International Programs
Support of International Fisheries Commissions

Agency for International Development.

The National Aeronautics and Space Administration has taken on the role of investigating the feasibility of doing useful and important jobs in oceanography using space technology developed as part of its major program in the Federal Government. (See chart 12.)

CHART 12

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

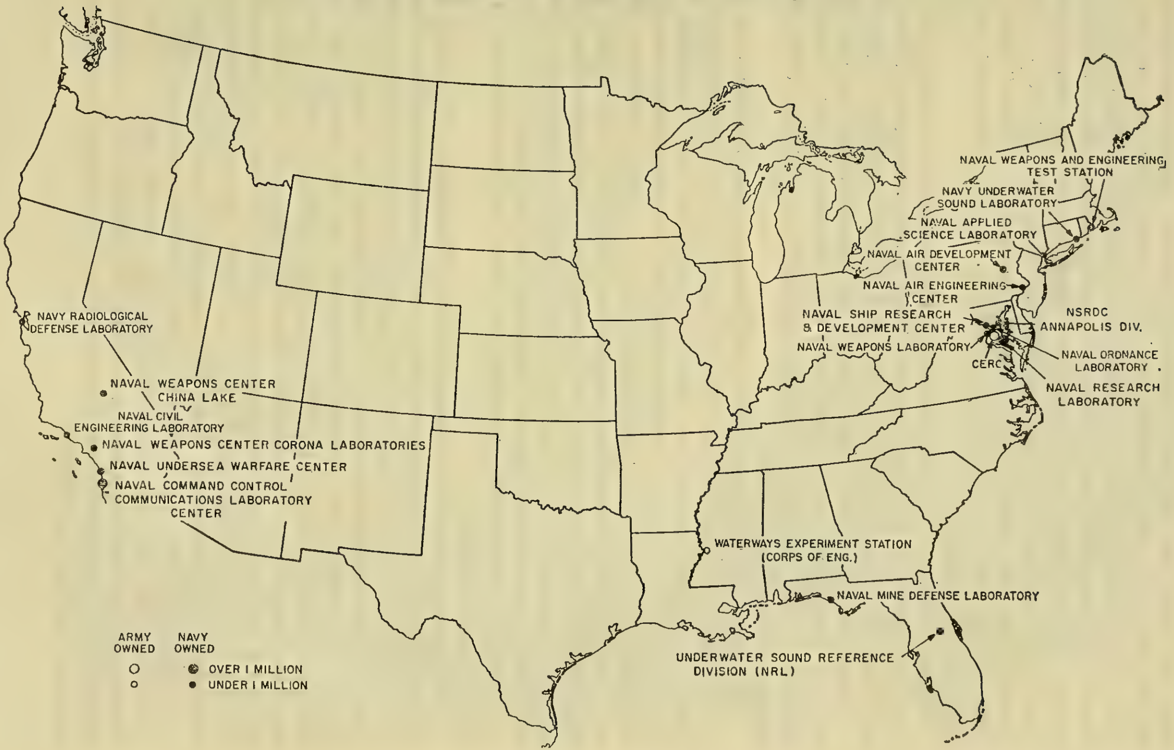
Feasibility of Oceanography From Space

I would now like to turn to some discussion of the laboratories which are operated by the Federal establishment and which support the research in marine sciences. To keep the laboratory charts from becoming cluttered we have arbitrarily divided them into Defense Department laboratories and non-Defense laboratories, a useful division for charting purposes. The first chart is the Department of Defense oceanographic laboratories or laboratories that have as a major portion of their mission marine and oceanographic scientific research requirements and oceanographic technological requirements. (See chart 13.)

I think this is one occasion where you will be able to deal with the chart better by referring to the small-scale version before you than by looking at the large-scale version, which might be difficult to read. Most of these laboratories are naval laboratories. They generally have naval development and warfare missions as well as requirements to do oceanographic research and marine technology development connected with those missions.

Chart 13

DEPARTMENT OF DEFENSE OCEANOGRAPHIC LABORATORIES


NAVAL WEAPONS AND ENGINEERING TEST STATION
NAVY UNDERWATER SOUND LABORATORY
NAVAL APPLIED SCIENCE LABORATORY
NAVAL AIR DEVELOPMENT CENTER
NAVAL AIR ENGINEERING CENTER
NAVAL SHIP RESEARCH & DEVELOPMENT CENTER
NSRDC ANNAPOLIS DIV.
NAVAL WEAPONS LABORATORY
CERC
NAVAL ORDNANCE LABORATORY
NAVAL RESEARCH LABORATORY
NAVY RADIOLOGICAL DEFENSE LABORATORY
NAVAL WEAPONS CENTER CHINA LAKE
NAVAL CIVIL ENGINEERING LABORATORY
NAVAL WEAPONS CENTER CORONA LABORATORIES
NAVAL UNDERSEA WARFARE CENTER
NAVAL COMMAND CONTROL COMMUNICATIONS LABORATORY CENTER
WATERWAYS EXPERIMENT STATION (CORPS OF ENG.)
NAVAL MINE DEFENSE LABORATORY
UNDERWATER SOUND REFERENCE DIVISION (NRL)
ARMY OWNED
NAVY OWNED
○ ● OVER I MILLION
○ ● UNDER I MILLION

Two of the laboratories are, of course, the laboratories of the Army Engineers and are concerned with the Corps' waterways development responsibilities.

The next chart shows the laboratories of the Federal establishment outside of the Department of Defense. We numbered these and coded them so that you will be able to tell which agency or department is responsible for each laboratory. We have tried to caption them so that you can tell what the major business of the laboratory is. In the lower left you will see a block of captions that lists the laboratories which do not appear on the chart because they are located elsewhere than the continental United States, being in Hawaii, Alaska, the Canal Zone, et cetera. It is clear from both of these charts that the laboratories are located where the water is. This seems to be a reasonably logical scheme.

Water clearly includes not only the seashore around the edges of the United States but also the Great Lakes as part of the national seashore and the national oceanographic responsibility. (See chart 14.)

I realize that it will be difficult for you to absorb all of the material on the charts as rapidly as I can present it, but I hope that the material will be useful for the committee's studies, aside from my presentation this morning.

The next chart represents an attempt to map the major academic oceanographic institutions, the ones that have the teaching and education of students, as well as research, as part of their mission. We have not been able to put on this chart all of the organizations that report themselves as teaching oceanography or marine sciences. As far as we are able to determine, the ones on this chart, however, represent approximately 95 percent of the national academic effort in marine sciences as measured either by expenditure of the school or by number of faculty members. Here, of course, the interests of the institutions are strongly dependent on their proximity to the ocean or to the Great Lakes. (See chart 15.)

The next chart also is packed with information. It shows the major academic and private laboratories, and the criterion for inclusion here is an annual expenditure in the marine sciences on the order of one-half million dollars or more in funds from all sources. We have indicated the location of these laboratories on the charts and have provided a pie-cut diagram showing source of funds, which is color coded on the large chart. I believe in the small ones you will have to find the code by the position on the pie diagram. The coding gives the source of the major support as Navy, (or, more generally, Defense Department), NSF, university and State support, and other support.

It was difficult to make any finer breakdown than that shown by the diagrams and still have any kind of coherency in the chart. If there are particular questions that are raised by this chart, we can provide the committee with more detailed information whenever you require it. (See chart 16.)

CHART 14

FEDERAL NON-DEFENSE OCEANOGRAPHIC LABORATORIES

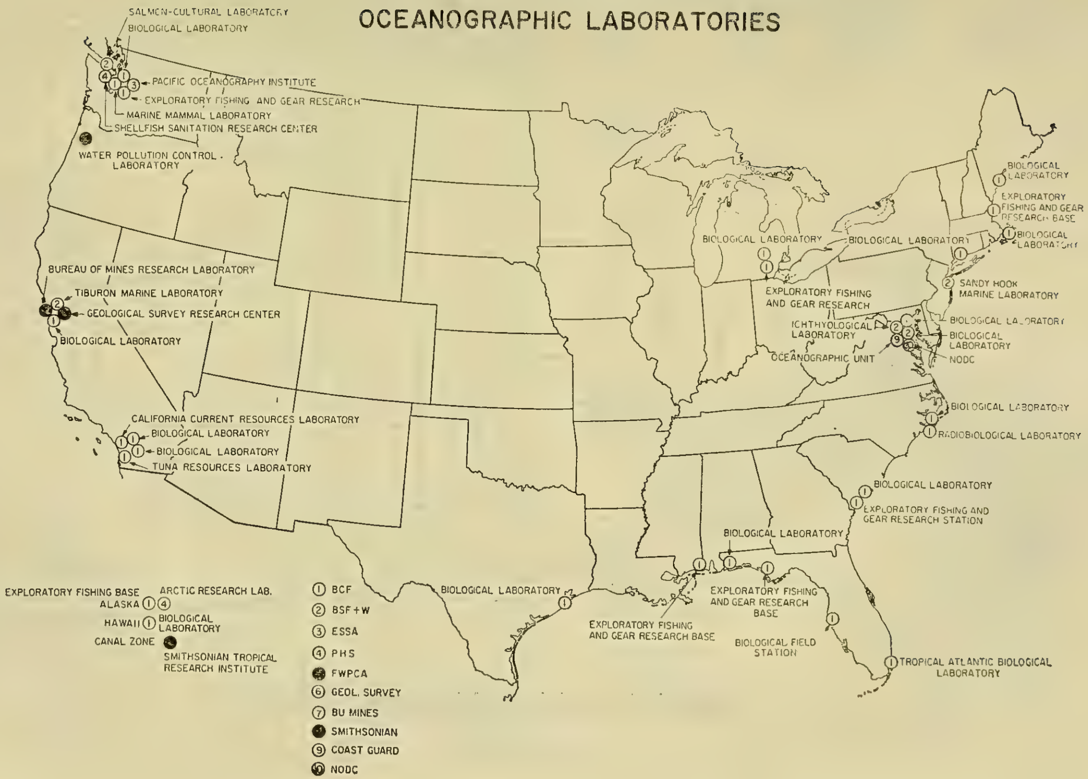

SALMON-CULTURAL LABORATORY
BIOLOGICAL LABORATORY
PACIFIC OCEANOGRAPHY INSTITUTE
EXPLORATORY FISHING AND GEAR RESEARCH
MARINE MAMMAL LABORATORY
SHELLFISH SANITATION RESEARCH CENTER
WATER POLLUTION CONTROL LABORATORY
BUREAU OF MINES RESEARCH LABORATORY
TIBURON MARINE LABORATORY
GEOLOGICAL SURVEY RESEARCH CENTER
BIOLOGICAL LABORATORY
CALIFORNIA CURRENT RESOURCES LABORATORY
BIOLOGICAL LABORATORY
BIOLOGICAL LABORATORY
TUNA RESOURCES LABORATORY
EXPLORATORY FISHING BASE ALASKA ① ④ ARCTIC RESEARCH LAB.
HAWAII ① BIOLOGICAL LABORATORY
CANAL ZONE ● SMITHSONIAN TROPICAL RESEARCH INSTITUTE
① BCF
② BSF+W
③ ESSA
④ PHS
● FWPCA
⑥ GEOL. SURVEY
⑦ BU MINES
● SMITHSONIAN
⑨ COAST GUARD
⑩ NODC
BIOLOGICAL LABORATORY
BIOLOGICAL LABORATORY
BIOLOGICAL LABORATORY
EXPLORATORY FISHING AND GEAR RESEARCH BASE
BIOLOGICAL LABORATORY
BIOLOGICAL LABORATORY
EXPLORATORY FISHING AND GEAR RESEARCH
SANDY HOOK MARINE LABORATORY
BIOLOGICAL LABORATORY
ICHTHYOLOGICAL LABORATORY
BIOLOGICAL LABORATORY
OCEANOGRAPHIC UNIT
NODC
BIOLOGICAL LABORATORY
RADIOBIOLOGICAL LABORATORY
BIOLOGICAL LABORATORY
EXPLORATORY FISHING AND GEAR RESEARCH STATION
BIOLOGICAL LABORATORY
BIOLOGICAL LABORATORY
EXPLORATORY FISHING AND GEAR RESEARCH BASE
EXPLORATORY FISHING AND GEAR RESEARCH BASE
BIOLOGICAL FIELD STATION
TROPICAL ATLANTIC BIOLOGICAL LABORATORY

CHART 15

OCEANOGRAPHIC INSTITUTIONS

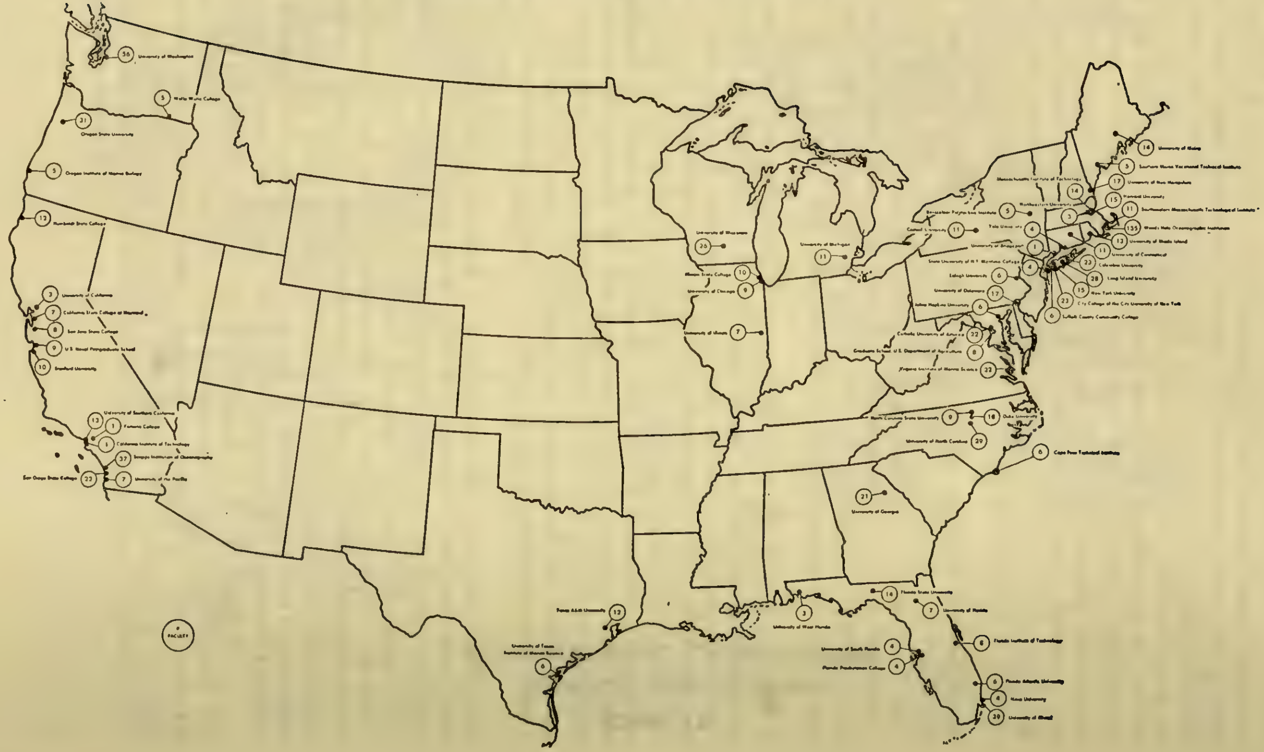
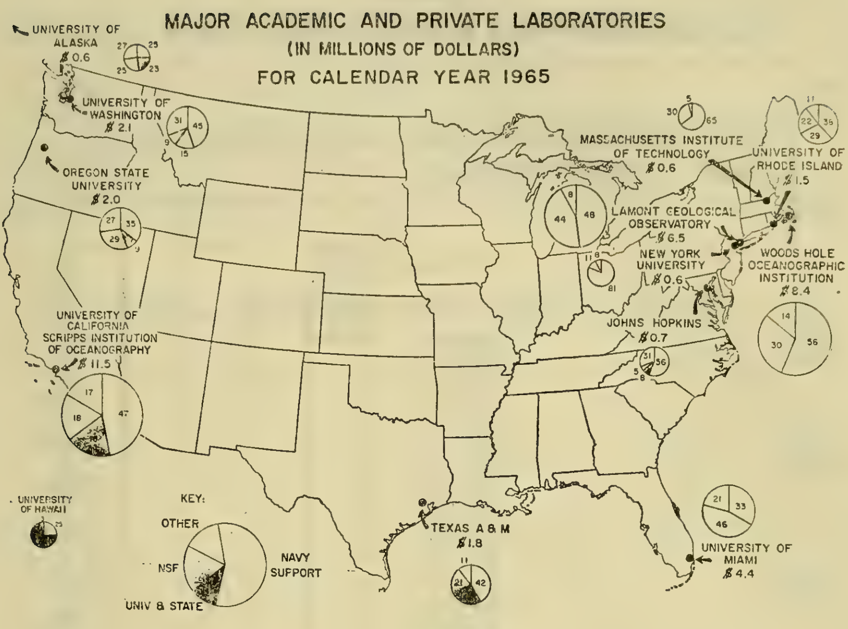

36 University of Washington
5 Walla Walla College
31 Oregon State University
5 Oregon Institute of Marine Biology
12 Humboldt State College
3 University of California
7 California State College at Hayward
8 San Jose State College
9 U.S. Naval Postgraduate School
10 Stanford University
13 University of Southern California
1 Pomona College
1 California Institute of Technology
37 Scripps Institution of Oceanography
22 San Diego State College
7 University of the Pacific
26 University of Wisconsin
10 Illinois State College
9 University of Chicago
7 University of Illinois
11 University of Michigan
14 University of Maine
5 Southern Maine Vocational Technical Institute
17 University of New Hampshire
14 Massachusetts Institute of Technology
15 Harvard University
Northeastern University 3
11 Southeastern Massachusetts Technological Institute
135 Woods Hole Oceanographic Institution
13 University of Rhode Island
11 University of Connecticut
Rensselaer Polytechnic Institute 5
Cornell University 11
Yale University 4
University of Bridgeport 1
State University of N.Y. Maritime College 4
Lehigh University 6
University of Delaware 17
Johns Hopkins University 6
23 Columbia University
28 Long Island University
15 New York University
23 City College of the City University of New York
6 Suffolk County Community College
Catholic University of America 22
Graduate School, U.S. Department of Agriculture 8
Virginia Institute of Marine Science 22
North Carolina State University 9
18 Duke University
University of North Carolina 29
6 Cape Fear Technical Institute
21 University of Georgia
14 Florida State University
7 University of Florida
3 University of West Florida
8 Florida Institute of Technology
University of South Florida 4
Florida Presbyterian College 4
6 Florida Atlantic University
4 Nova University
29 University of Miami
Texas A&M University 12
University of Texas Institute of Marine Science 6
# FACULTY

CHART 16

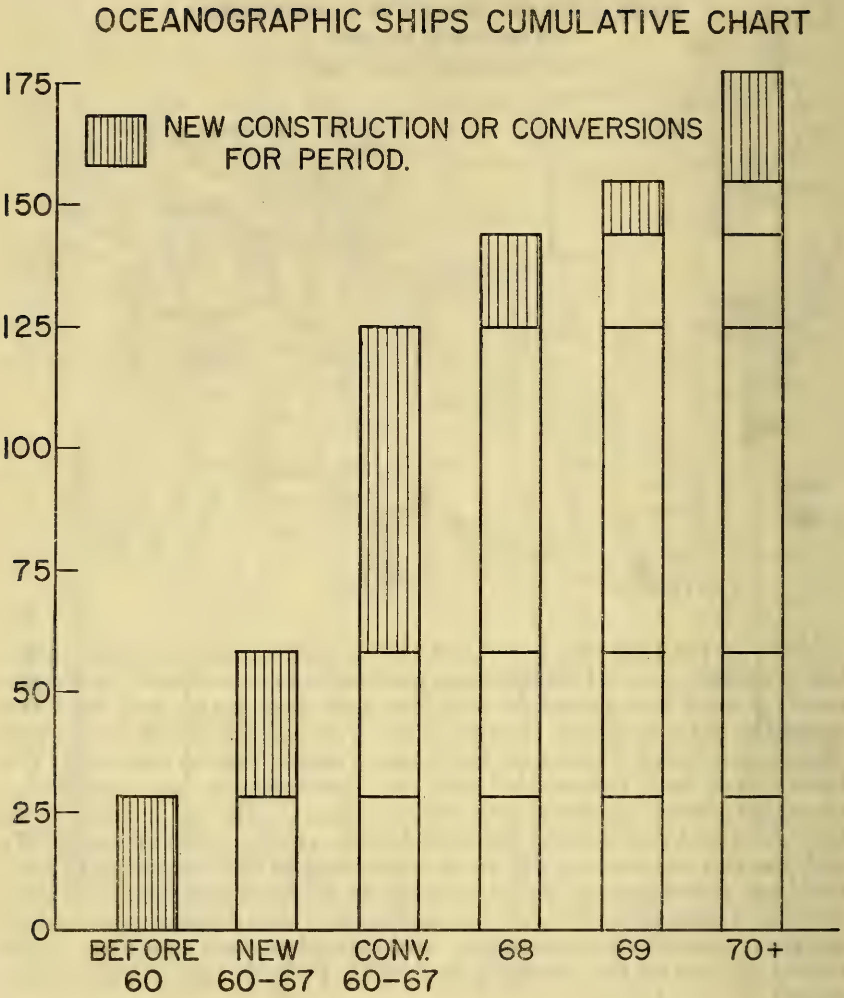

MAJOR ACADEMIC AND PRIVATE LABORATORIES
(IN MILLIONS OF DOLLARS)
FOR CALENDAR YEAR 1965
UNIVERSITY OF ALASKA $0.6
27
25
25
23
UNIVERSITY OF WASHINGTON $2.1
31
45
9
15
OREGON STATE UNIVERSITY $2.0
27
35
29
9
UNIVERSITY OF CALIFORNIA SCRIPPS INSTITUTION OF OCEANOGRAPHY $11.5
17
47
18
18
UNIVERSITY OF HAWAII
25
KEY:
OTHER
NSF
NAVY SUPPORT
UNIV & STATE
TEXAS A & M $1.8
11
21
42
MASSACHUSETTS INSTITUTE OF TECHNOLOGY $0.6
5
30
65
UNIVERSITY OF RHODE ISLAND $1.5
11
22
35
29
LAMONT GEOLOGICAL OBSERVATORY $6.5
8
44
48
NEW YORK UNIVERSITY $0.6
11
8
81
WOODS HOLE OCEANOGRAPHIC INSTITUTION $8.4
14
30
56
JOHNS HOPKINS $0.7
31
56
5
8
UNIVERSITY OF MIAMI $4.4
21
33
46

Now, on the next chart we have shown the way in which the number of ships dedicated to oceanographic and marine scientific and engineering work has increased over the past few years, and we have coded the chart so that it is cumulative. You can see in any year what was accomplished to increase the oceanographic fleet in that year. We have mixed both conversions and new construction, but principally the ships shown represent new construction in the last 3 years. The new ships and conversions are split for the period 1960 through 1967, and you can see that we did more converting in that period than new building. Subsequently, we have begun to do more building than converting. These ships include, of course, the Coast Guard cutters that are partly or wholly dedicated to oceanographic work as well as Navy survey ships and the research fleet, both Federal and private. (See chart 17.)

The next chart shows you Federal oceanographic funding in the period 1960 through 1968. The red line, which is the solid line on the small charts, is what we have called the national oceanographic program. This is the national oceanographic program as it was carried in the listings of the Interagency Committee on Oceanography, before the foundation of the Council and the Commission, and as extrapolated through 1968 on that red line.

As a matter of interest, we have put in the dashed line which shows the actual growth, according to the Interagency Committee on Oceanography definitions, as compared with the growth that was estimated in 1963 in the report "Oceanography 10 Years Ahead." You can see by that definition the trend has been above the prediction.

CHART 17



The dotted lines and the three circled points represent the funding of the Federal oceanographic program as defined in the Council report "Marine Science Affairs." Under the definition of marine sciences provided by Public Law 89–454, the definition is somewhat broader than the definition that was being used by the ICO. Consequently, there has been a change in the amount of funding attributed to the oceanographic program. One of the major differences in the increase is the fact that the definition now being used includes the classified oceanographic program of the Navy, whereas the old definition of the ICO excluded that program. That makes a difference in the fiscal 1968 President's budget of about $116 million.

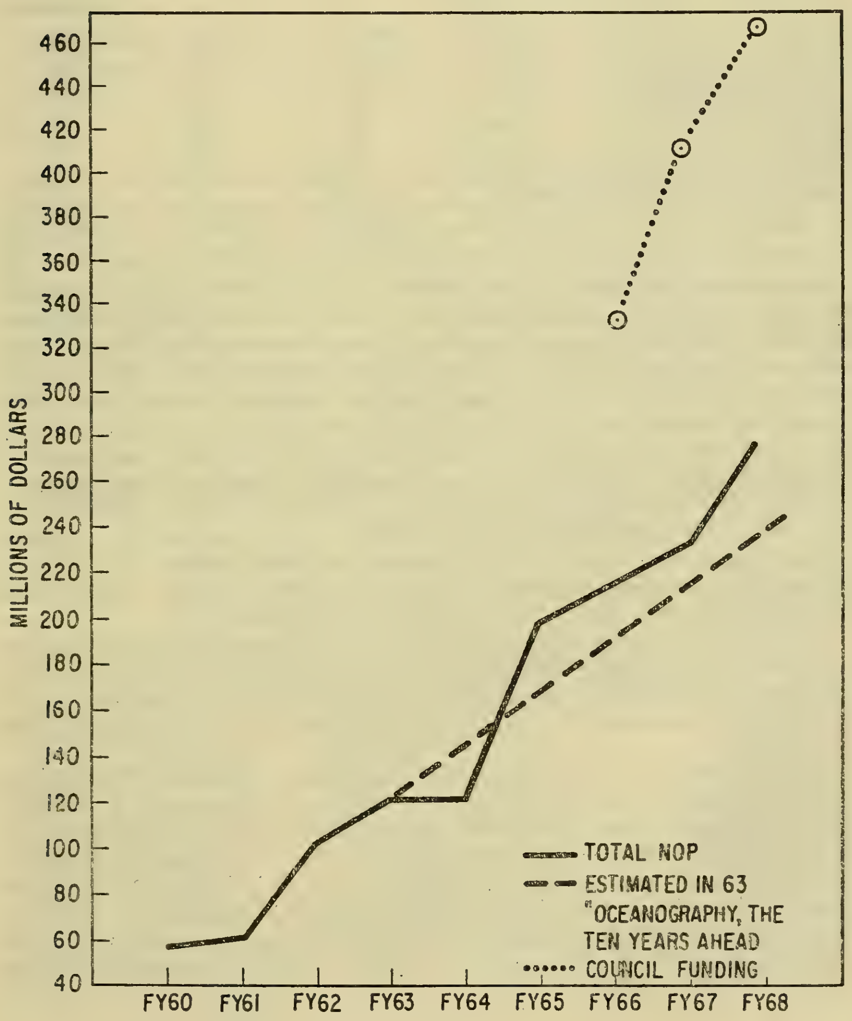
There are a number of other differences in other agencies and departments, some difference in the definition of what is included for every department, major differences for the Department of Interior and the Department of Commerce, small differences in the case of other departments. (See chart 18.)

Mr. MOSHER. Do you make public in dollar amounts the measure of your classified work?

Dr. FROSCH. In the case of oceanography we have made public the aggregate amount. Inasmuch as this is a lumped amount which covers

CHART 18

FEDERAL OCEANOGRAPHIC FUNDING, FY 1960–68



a very large number of programs we think that it is not particularly revealing. We do not care to break that aggregate down at all, publicly.

The next two charts show the breakdown of the program in the past 3 years, in two different ways. The first is the breakdown of the program by department and agency, and it shows the actual obligations as found at the end of fiscal year 1966. (See chart 19.)

CHART 19

FEDERAL MARINE SCIENCE AND TECHNOLOGY PROGRAM PLAN, FISCAL YEAR 1966–68, BY AGENCY

[In millions of dollars]

	Actual, fiscal year 1966	Estimated, fiscal year 1967	President's budget, fiscal year 1968
Defense	$174.9	$235.8	$258.7
Commerce	25.0	32.5	36.0
Interior	56.5	71.2	72.3
National Science Foundation	47.7	29.0	40.1
Atomic Energy Commission	8.3	13.7	15.8
Health, Education, and Welfare	5.4	7.0	4.8
Transportation	8.1	10.8	24.6
Smithsonian Institution	1.5	1.6	1.8
State	5.0	5.1	5.4
Agency for International Development	.1	2.0	2.0
National Aeronautics and Space Administration	.9	.4	.8
Total	333.4	409.1	462.3

Our current estimate of the situation in fiscal 1967 is shown because the final auditing and closure of 1967 books is not officially complete. So this is regarded as an estimate. Also, we show the President's budget submitted for fiscal 1968. As you can see, there has been a pronounced increase in the total amount budgeted above that previously expended, and this is, generally speaking, an increase across the board—some increase in the case of every department and agency. In the one case in which there is an exception, Health, Education, and Welfare, the change is due entirely to the fact that facilities construction was budgeted in the previous year, and, as it happens in the 1968 budget, there was no request for construction of facilities. Thus, the decrease has to do with that one lump change rather than any change in the level of effort of that department.

The next chart shows you a breakdown of the programs and plans by, what I might call, functional area research and development, investment, by which we mean purchase of ship's equipment and facilities, and operations, including surveys, services, and so on. (See chart 20.)

In a general way, the Committee on Marine Research, Education, and Facilities is responsible for research and development and for the investment areas. I say "in general" because there are specific areas for which other committees appointed by the Council are responsible and in as aggregated a chart as this is, it is impossible to draw the precise differences. But roughly speaking, we are starting out assuming we are responsible for these areas, and as we examine the details we identify the areas in which the other committees have responsibility. And, we are performing direct liaison with those com-

CHART 20

FEDERAL MARINE SCIENCE AND TECHNOLOGY PROGRAM PLAN, FISCAL YEARS 1966–68, BY FUNCTIONAL AREA

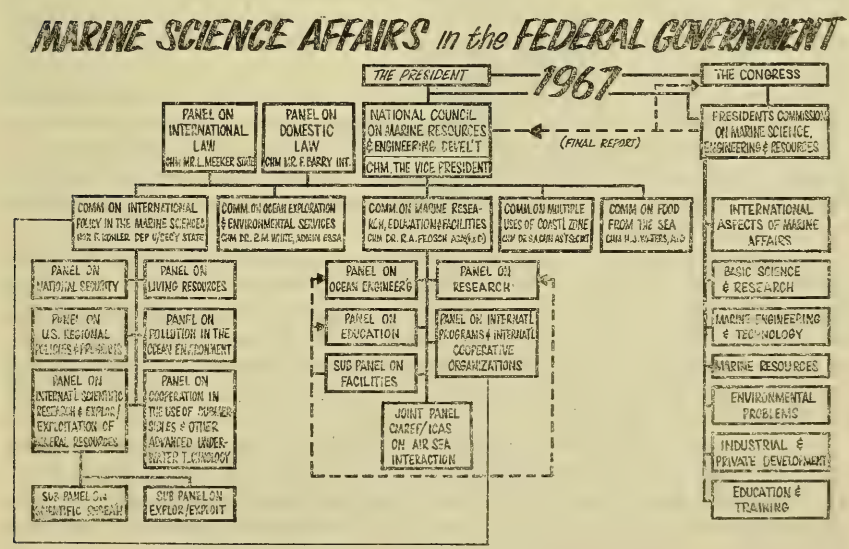
[In millions of dollars]

	Actual, fiscal year 1966	Estimated, fiscal year 1967	President's budget, fiscal year 1968
Research and development	$194.7	$224.6	$262.7
Research (basic and applied)	122.3	121.5	138.1
Development of new equipment and technology	72.4	103.1	124.6
Investment	46.8	66.8	72.0
Ships	29.4	35.7	28.8
Major equipment	9.1	16.3	30.7
Shore facilities	4.8	9.5	6.2
Other	3.5	5.3	6.3
Operations	91.9	117.7	127.6
Surveys	68.9	89.2	100.6
Services	20.1	25.1	23.1
Other operations	2.9	3.4	3.9
Total	333.4	409.1	462.3

mittees, so that we can untangle whose problem is whose and who is taking the prime responsibility for each individual item. The final chart shows the current organization in the Federal Government as we understand it, including the panels and major subpanels of the committees appointed by the Council and by the Commission. (See chart 21.)

The red dotted lines, that carry around the committee that I represent, indicate that we have established a subpanel on facilities which we are not regarding as an independent panel but rather as a co-

CHART 21


MARINE SCIENCE AFFAIRS in the FEDERAL GOVERNMENT
1967
THE PRESIDENT
THE CONGRESS
PANEL ON INTERNATIONAL LAW CHM MR. L. MEEKER STATE
PANEL ON DOMESTIC LAW CHM MR. F. BARRY INT.
NATIONAL COUNCIL ON MARINE RESOURCES & ENGINEERING DEVEL'T
CHM. THE VICE PRESIDENT
(FINAL REPORT)
PRESIDENTS COMMISSION ON MARINE SCIENCE, ENGINEERING & RESOURCES
COMM ON INTERNATIONAL POLICY IN THE MARINE SCIENCES MR F. KOHLER DEP U/SEC'Y STATE
COMM. ON OCEAN EXPLORATION & ENVIRONMENTAL SERVICES CHM DR. R.M. WHITE, ADMIN ESSA
COMM. ON MARINE RESEARCH, EDUCATION & FACILITIES CHM DR. R.A. FROSCH ASN(R&D)
COMM. ON MULTIPLE USES OF COASTL ZONE CHM DR S.A. CAIN ASTSECINT
COMM ON FOOD FROM THE SEA CHM H.J. WATERS, AID
INTERNATIONAL ASPECTS OF MARINE AFFAIRS
PANEL ON NATIONAL SECURITY
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PANEL ON U.S. REGIONAL POLICIES & PROGRAMS
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BASIC SCIENCE & RESEARCH
MARINE ENGINEERING & TECHNOLOGY
MARINE RESOURCES
ENVIRONMENTAL PROBLEMS
INDUSTRIAL & PRIVATE DEVELOPMENT
EDUCATION & TRAINING

· NOTE: Chairman, Committee on International Policy in the Marine Sciences plans to consolidate panel structure

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ordinative mechanism among three of the panels that sit formally, so that we can extract from the discussions on engineering, on education, and on research, the implications of the panels' requirements for facilities. We think this will be a better way to be sure we are keeping track of facilities requirements than by having a completely independent facilities panel.

Mr. Chairman, that completes the formal discussion that I had proposed to make on the overview of the Federal activities. At your pleasure we can discuss that or I can proceed to a few comments on the Navy's position in the program.

Mr. Lennon. I think we would like to have those comments at this time before we start the questioning.

Dr. Frosch. Fine; thank you Mr. Chairman.

The Navy's principal responsibility and concern in the national oceanographic program is, of course, to do that work in marine sciences and engineering that will enable it to support and maintain its responsibilities for the national security and for the naval force at sea.

As an automatic consequence of the requirements for doing that, the Navy has been a major supporter and, in fact I think by actual proportion, the major supporter of oceanographic science and marine technology in the United States, because our requirements for this kind of knowledge and this kind of technology have been so great for naval purposes.

Approximately two-thirds of the total naval work in this field is regarded as unclassified science and technology and is, hence, automatically available to the rest of the national community, Federal and private.

In the portion which is classified, it is normally classified in two senses: One, classified at the time at which the work is being done, and two, the military consequences are normally classified. But, a proportion of what is developed in the classified program after some time lag normally finds its way into the general body of unclassified technology as pure engineering, or into the general body of scientific knowledge as pure scientific knowledge.

We try to hold back as classified only those matters that have quite clear and direct bearing on military problems or military operations. We are reasonably careful with this, and I believe we have been able to extract from the classified work good benefits for the unclassified side of the house without in any way damaging or endangering our security responsibilities.

The overall proportion of the Navy's support in the national marine science program has generally been about 50 or 60 percent, and it is that at the present time. Of course, as a matter of historical interest, in the late forties and throughout most of the fifties, it was Navy support, principally through the Office of Naval Research, that played a major role in building up the academic as well as a good deal of the Government capability in this area.

A secondary responsibility and role for the Navy, secondary only to our national security responsibility, is the use of capabilities that we have built up in our national security program specifically to provide support for other agencies of the Federal Government and for other sectors in their responsibilities in marine sciences.

We have had discussions during the past months with the Office of the Secretary of Defense, and with the Secretary, in regard to the manner in which this responsibility might best be carried out. It is his stated policy that it is practical and proper for the Navy when it identifies areas in which its support should be given to other Federal Government organizations—but where the particular work to be done cannot be justified specifically as a national security matter—to volunteer essentially to undertake the work, to present to the Congress the possibility of doing this, and to request that funds be appropriated specifically so that it can undertake non-national security work in support of other portions of the national marine program.

We have not yet come to the Congress with such a request, but it is possible that as various developments take place in the Federal program it will be appropriate for us to do so.

I think with these comments, Mr. Chairman, I have completed what I would like to say formally, and I stand ready to answer any questions.

Mr. LENNON. Mr. Secretary, are you generally the designee of the Secretary of the Navy to participate in the National Council's monthly meetings which have been going on now, on a monthly basis, since August 17 of 1966?

Dr. FROSCH. Mr. Chairman, I am not. The Secretary of the Navy, himself, is the designee of the Secretary of Defense to be the Department of Defense representative on the Council, and the Secretary of the Navy has attended either all or all but one of the Council's meetings personally.

I have generally gone with him to assist him should he wish any information that I might be able to provide.

Mr. LENNON. My recollection of the language of the act is that the Secretary of the Navy is a member and does not have to be designated by the Secretary of Defense to participate in the Council. Isn't that true?

Dr. FROSCH. I think that is correct, but in any case there was a formal designation, even though the act so stated.

Mr. LENNON. The reason I ask you that is I noted from the minutes of several meetings of the Council that you had been present.

Dr. FROSCH. Yes.

Mr. LENNON. I would like for you to, if you will, give us off the top of your head, your impressions of the activities of the Council since its first meeting on August 17 of last year.

Dr. FROSCH. Mr. Chairman, I was present at many of those meetings not only to assist the Secretary of the Navy but also as Chairman of the Interagency Committee on Oceanography, before the formation of the present committee.

The Council has been extremely active. It has met a number of times, as you know, with the Vice President always in the chair. It has had excellent representation at those meetings from the various departments and agencies that are members.

Perhaps its major activity, in my mind, has been an attempt to find new ways and new initiatives which would enhance our national program as well as to examine the existing programs and see whether there are areas in which interdepartmental and joint departmental cooperation might strengthen the program.

There has been a great deal of activity in looking at such initiatives. A number of initiatives were discussed in the Council's report, and a number are now under discussion.

Mr. LENNON. Mr. Secretary, you are familiar, of course, with the request of both the Council and the Commission through a letter directed to the Speaker of the House and the President of the Senate over the signature of the Director of the Bureau of the Budget requesting extension for 6 months for the life of the Commission and also providing, too, for the extension of the life of the Council for 6 months after the target date for the submission of the Commission's report.

I take it that you are in agreement with that and realize the objective purposes which are sought.

Dr. FROSCH. Yes, I do. I think that is a most reasonable thing to do. I think if we did not have that, if the Congress felt unwilling to authorize the requested extensions, we would run some risk that the reports and the actions would come out at a time when they might not receive the attention which, I think, we would all like to have them receive.

Mr. LENNON. Mr. Secretary, as Chairman of this newly established committee which took the place of the ICO, you are familiar with the mineral and oil leases that the Department of Interior negotiates with various sectors of private enterprise. Is it your understanding that those leases go beyond the Continental Shelf or out to the Continental Shelf?

Dr. FROSCH. If I remember correctly the discussions I have had about that, I think that some of them would be considered to go beyond the Continental Shelf in the strict definition of the shelf.

Mr. LENNON. I was able to obtain some figures about a week ago concerning the actual dollar amounts that were paid to the Department of the Interior for these leases. It ran into a considerable sum of money.

The thing that will have some interest in the light of the so-called Malta resolution which would in effect provide for turning over to the United Nations in trusteeship for all of the countries of the world, particularly the underprivileged and underdeveloped countries, the resources beyond the Continental Shelf. If the Department of Interior makes long-term contracts with the private sector beyond the Continental Shelf, what effect would that have on any effort in the United Nations to attempt to turn over to that body in trusteeship the sea bottoms beyond the Continental Shelf?

Dr. FROSCH. My understanding of the situation is that under the present convention on the Continental Shelf these leases fit under the portion of the convention that states exploitation of the Continental Shelf or beyond it to such depth as exploitation may be made. That is not the precise wording but I think it is a reasonable paraphrase. So that under the existing International Convention, which I would presume has the force of international law insofar as it bears upon such leasing, this is a perfectly reasonable and proper set of leases.

Presumably, if something as sweeping as the Malta Resolution were to come into effect, then unless there were a proviso that it excluded preexisting arrangements, there would certainly be some interference between the results of the Malta Resolution and the result of those leases.

Mr. LENNON. Mr. Secretary, what effect would the adoption of the so-called Malta Resolution by the United Nations have upon our national key defense posture with respect to the sea bottom beyond the Continental Shelf?

Dr. FROSCH. We think that certainly something as sweeping as that resolution would have a most serious effect on the Navy and on the Navy's role in the national defense posture.

I certainly cannot go into details in an unclassified way but I think that I can state, in fact, that the Navy uses the ocean and uses the bottom of the ocean and has for many, many years as part of its national security responsibilities, and it would be very difficult for us to avoid doing so without some considerable difficulty in carrying out our responsibilities.

Mr. LENNON. I saw some maps last week that purportedly were prepared after the Geneva Conference which circumscribed the continental United States. Due to the location in the Atlantic of a great many islands owned by the United Kingdom, this would give them jurisdiction almost to our shores. I am talking about the islands off our coast. I am thinking, too, about Portugal, whose islands expand their alleged sovereignty of the seas near our coastline.

You gave us some figures a few minutes ago with respect to the breakdown, and you mentioned the Department of Transportation. The Department of Transportation's interest in the oceanographic program is perhaps related to the fact that the Coast Guard is now under the Department of Transportation. Is that the basis on which the Department of Transportation is funded in the general oceanographic area?

Dr. FROSCH. Yes; I believe that is correct, Mr. Chairman.

Mr. LENNON. In chart 19, you show Department of Transportation, 8.1 actual in fiscal 1966; estimated fiscal 1967, 10.8; and President's budget fiscal 1968, 24.6. That would be related, as I understand it, primarily to the ocean station mission Coast Guard vessels which were adapted to some phases of the marine science technology. So that is the increase in the budget?

Dr. FROSCH. That is correct, Mr. Chairman. That reflects an increase in responsibility on the part of the Coast Guard. The increase between 1967 and 1968 includes the construction of a Coast Guard vessel, particularly, if I remember correctly, for subpolar oceanographic research. This has been a traditional Coast Guard responsibility, and one that I think everyone agrees it is proper for them to continue to take a major interest in.

Mr. LENNON. Mr. Secretary, in chart 9, you are speaking of HEW and oceanographic education, fellowships, and grants.

Again as the chairman of the committee and not in your specific characterization as Assistant Secretary of Navy for Research and Development, would you have furnished for the record what individuals and institutions—I think it would be interesting to members of the committee who get increasing inquiries from constituents as to how to qualify for a fellowship or a grant.

Would you furnish for the record what individuals and institutions are eligible for fellowships and grants under the oceanographic education program of Health, Education, and Welfare?

Dr. FROSCH. Certainly. I am sure that it would be of interest to the chairman and members of the committee to know that responding to such inquiries is a specific task of the Committee on Marine Research, Education, and Facilities, as it was of the ICO before it, and at present, we reply to approximately 12,000 such inquiries from the general public each year. The Committee on Marine Research would, of course, be pleased to supply replies to such inquiries to aid the members in their correspondence.

MARINE SCIENCE FELLOWSHIPS AND GRANTS

I. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

1. Experienced Teacher Fellowship Program—Graduate Fellowships administered by HEW, awarded by institutions of higher education. Apply: Director, Division of Educational Personnel Training, U.S. Office of Education, Washington, D.C. 20202.

2. National Defense Graduate Fellowship Program—Fellowships awarded to qualified individuals accepted in graduate programs approved for support by the Commissioner of Education. Apply: Fellowship, candidates apply directly to participating graduate institution. Institutions secure information from Graduate Academic Programs Branch, Bureau of Higher Education, Office of Education, Washington, D.C. 20202.

3. Prospective Teacher Fellowship Program—To be eligible for a fellowship award, a person must: 1) have completed the baccalaureate degree, 2) intend to pursue an advanced degree other than the doctorate, 3) intend to pursue a career in elementary or secondary education, 4) not hold an appointment in an elementary or, secondary school during the academic year preceding the fellowship, 5) be accepted for full-time graduate study in an approved program at the nominating institution, and 6) be a citizen of the United States or have such immigration status and personal plans as to indicate that he is in this country for other than a temporary purpose. Apply: Fellowship, candidates apply directly to participating graduate institution. Institutions secure information from Graduate Academic Programs Branch, Bureau of Higher Education, Office of Education, Washington, D.C. 20202.

II. NATIONAL SCIENCE FOUNDATION

1. Graduate Education in Science: The purpose of this program is to meet the specific needs of individuals who desire predoctoral and postdoctoral training in science, mathematics, and engineering, and, in turn, to help the graduate institutions to adjust to the demands of rapidly evolving science and technology. Projects for improving the American public's understanding of science also are included.

Specific titles of appropriate programs for U.S. citizens are:

Graduate Fellowships
Postdoctoral Fellowships (Regular)
Senior Postdoctoral Fellowships
Science Faculty Fellowships
North Atlantic Treaty Organization (NATO) Senior Fellowships and Postdoctoral Fellowships in Science
Graduate Traineeships (including Summer Traineeships for Graduate Teaching Assistants)
Advanced Science Seminars
Special Projects in Graduate Education
Public Understanding of Science

Graduate students and postdoctoral scholars in the sciences are eligible to apply for fellowships and traineeships in accordance with requirements and procedures described in the individual program announcements.

Universities, colleges, and appropriate nonprofit professional organizations may apply to NSF for grants to conduct programs and projects supported under the other listed programs. In the case of graduate traineeships, eligible institutions apply directly to NSF for grants for this program, but students apply to the institutions offering the traineeships.

Apply: Division of Graduate Education in Science, National Science Foundation, Washington, D.C. 20550.

2. Scientific Research Grants—Scientific research supported by grants for individuals and for large-scale coordinated research efforts. Graduate universities and undergraduate colleges are eligible to apply through the endorsement of proposals from individual scientists or faculty members. In special cases an individual scientist may apply. Apply: National Science Foundation, Washington, D.C. 20550.

3. Pre-college education in science grants to support teacher education. Secondary school teachers of science and mathematics are eligible to apply to institutions conducting NSF-supported teacher education activities. For information contact: Division of Pre-College Education in Science, National Science Foundation, Washington, D.C. 20550.

4. Undergraduate education in science—grants to improve scientific education at the undergraduate level. Scientific faculty at colleges and universities are eligible to apply to institutions conducting NSF-supported training projects. Undergraduate students may apply to institutions conducting undergraduate research participation projects. For information contact: Division of Undergraduate Education in Science, National Science Foundation, Washington, D.C. 20550.

5. (Sea Grant Program—Public or private institutions of higher education, and suitable institutes, laboratories and public or private agencies may be eligible for Sea Grant project support. The National Sea Grant Program does not at present include fellowships or scholarships; however, assistantships of various kinds necessary for the conduct of a particular project are allowable.)

III. DEPARTMENT OF THE INTERIOR

1. Federal Water Pollution Control Administration—Research Grants and Research Fellowships available to qualified individuals. Apply: Federal Water Pollution Control Administration, Department of the Interior, 633 Indiana Avenue, NW. Washington, D.C. 20242.

Mr. Lennon. I think it would be helpful because we frequently have inquiries on this subject.

If we might turn to charts 13 and 14 identified as Department of Defense Oceanographic Laboratories and then turn to chart 15, Oceanographic Institutions, I do not mean to be provincial, but I am trying to find out who made this map when they came down to the coastline of North Carolina.

Dr. Frosch. Have we made an error, sir?

Mr. Lennon. Well, I want to find out. I know something about the coastline of North Carolina with respect to the Virginia line and the South Carolina line and I am interested in a little institution down there called the Cape Fear Technical Institute. I am asking you the question if it is not inaccurately located with respect to the coastline of North Carolina.

Dr. Frosch. I think that is probably right, sir.

Mr. Lennon. I think it is because Wilmington, N.C.——

Dr. Frosch. Yes. It is one cape north, is it not?

Mr. Lennon. You have us up there about Cape Lookout when we ought to be down nearly on the South Carolina line. It is the mouth of the Cape Fear River.

Dr. Frosch. I apologize. It is always poor to make a mistake in geography and always worse when it is in the State of the chairman.

Mr. Lennon. Just for the record, I did not want it to pass.

Dr. Frosch. We will provide a correction for the record.

Mr. Lennon. I noticed, too, in chart 16, which indicates a map of major academic and private laboratories, and I am asking you if you know anything about the research center, the Medical Biological Research Center. It is located at Wrightsville Beach, near Wilmington, N.C., and operated by the Medical Schools of Duke University, University of North Carolina, and Bowman-Gray School of Medicine of Wake Forest. It has some high people in the medical-biochemical world connected and related to it, and I notice it is not shown. It is a public facility. Maybe you want to consider that for your next map.

Dr. Frosch. It is not shown because I believe it does not have an annual funding of over $500,000. It might be slightly under that but that was the criterion for the chart. It is, of course, in our listing of institutions.

Mr. Lennon. Maybe we will get to that in time.

Thank you very much.

The gentleman from Ohio?

Mr. Mosher. Dr. Frosch, the Chairman referred to various leases granted by the Department of Interior for use of the ocean's bottom. Is the liaison such between the Department of Interior and the Navy Department that they check with you and check with you very carefully before they grant such leases? I should think you would want that done.

Dr. Frosch. They do check with the Department of Defense and the Department concurs in those leases granted. In fact, it is normal for there to be close liaison between the Department of the Interior and the Department of Defense in all matters having to do with offshore lands so that we can be sure we are coordinated on military and other uses of those lands, and so that, when necessary, we can make adjustments in one use or the other to avoid conflict and to avoid making unnecessary problems.

Mr. Mosher. Mr. Chairman, it was my privilege last Thursday and Friday to participate in a conference out at Ohio State University in Columbus, concerned with the oceanographic future and particularly with international aspects of it and regional aspects, the whole question of a regime, the possibility of a world regime giving direction to and governing oceanographic activities. I found it very interesting that of the 30 or so knowledgeable people there representing many points of view, there seemed to be unanimity that agreed with the unanimity here in Congress, that we have to go very slow in considering such proposals as the Malta Resolution.

Dr. Frosch participated in the conference on Saturday when I could not be there.

Dr. Frosch. Yes.

Mr. Mosher. I would guess you made it very plain there, and there was probably discussion, that among the various reasons that we have to go slow concerning the Malta Resolution, is considerations of defense and particularly your classified use of the ocean's bottom?

Dr. Frosch. I did make it clear and I would be happy to provide you with a copy of the paper that I presented——

Mr. Mosher. I have a copy.

Dr. Frosch (continuing). At the meeting, which I think made it very clear that we have that problem.

Mr. MOSHER. Mr. Chairman, it might be that paper would be very appropriate for incorporation in the record of this committee.

Mr. LENNON. What specific paper is that?

Mr. MOSHER. This is a paper Dr. Frosch presented at the conference in Ohio last week, in which he discussed the Navy's concern with proposals such as the Malta Resolution.

Mr. LENNON. Without objection, if you will furnish that for the record it will appear following your statement and interrogation.

Dr. FROSCH. We will be happy to.

Mr. LENNON. We will be glad to have it for the record.

(The address mentioned follows:)

ADDRESS BY THE HONORABLE ROBERT A. FROSCH, ASSISTANT SECRETARY OF THE NAVY FOR RESEARCH AND DEVELOPMENT

INTRODUCTION

"Military Uses of the Ocean" is an exceedingly broad and complex subject. In presenting some of the present day manifestations of military use of the sea, together with some of the legal problems, oceanographic implications, and future thinking I want to take a quite strictly military view, that is, to present the subject from the point of view of National Security viewed fairly narrowly in terms of the protection of the United States in its present circumstances. This can provide a firm background for discussion both by introducing these views and possibly by throwing down some gauntlets. There are, of course, other non-military interests of the United States which must be taken into account in the formulation of national policy. I will put some emphasis on the technical background requirements of the military uses.

In order to develop the rationale behind military use of the sea, it would be well to first discuss it in a general sense based on taxonomy of military uses.

Many military uses of the ocean stem from general uses of the ocean: Where man goes his problems go, where man's problems go his conflicts go, and where man's conflicts go his military forces follow. A second class of military uses of the ocean stem from special properties of the ocean, including the fact that there is no sovereignty there, the fact that the sea provides special kinds of concealment, and the fact that it is an arena generally empty of human population concentrations. A third class of military uses stems from uses generated in response to the military uses called out by the first two classes, and by those in the third class. (I fold the third class into itself to avoid a useless sequence.)

In the first class (military uses generated in response to non-military uses) we find policing problems, including the protection of our own shipping, fishing, shores, and property at sea.

In the second class (military uses generated from special properties of the sea) we may put deterrence forces, sea based forces for attacks on foreign shores, and forces based at sea for surveillance of foreign activities. The ocean is also used as a convenient place for testing of some military systems.

In the third class (military uses generated by other military uses) we may put anti-submarine warfare (ASW), air defense of and attacks on fleets, submarine attacks on fleets, surveillance of military forces, etc. We also include here the problem of providing the scientific and technological basis for military use of the sea.

The remainder of this paper will describe some of the particular uses and consequences in a general way, to try to provide some basic information on military interests in the oceans.

Some Specific Military Uses of the Sea

In general, the United States Navy may be considered to be made up of Strategic Deterrent Forces (class two), Anti-Submarine Warefare Forces (class three), and Tactical Forces (all three classes).

The first basic force structure is the Strategic Deterrent Forces, in particular, our Fleet Ballistic Missile submarines. The success of the POLARIS program as a major component of our national strategic deterrence system, has thrust the POLARIS submarine to the fore. POLARIS, with a high degree of invulnerability, has become a cornerstone of the Nation's strategic forces. This submarine system relies on the ability to hide in the ocean for its invulnerability. It is a flexible system and highly mobile. In many ways it would appear to be an ideal deterrent to nuclear warfare for a long time. The mobility aspect can only be limited by further limitation on use of the sea.

Future design of sea based deterrents following POLARIS/POSEIDON may take many forms. Underwater silos, for example, are a possibility. Should that be so it may be that the maritime nuclear powers would like to keep the continental shelves and deep ocean available for some use by such military systems. This, however, would not necessarily be a bar to use of these areas or the ocean bottom for exploration and exploitation of natural resources.

The next major subdivision of Naval forces is the Anti-Submarine Warfare Forces. The submarine threat to the United States has been and is expected to remain a very serious consideration in defense planning. The Soviet Union now has a large submarine force consisting both of nuclear and non-nuclear ships. This force is being modernized and increased in size on an intense scale. Red China has built a sizeable submarine force (third largest in terms of operational ships in the world), and even smaller powers such as North Korea and Egypt have conventionally-powered submarine forces.

The submarine threat jeopardizes both our naval forces and our merchant shipping. In addition, the missiles carried by foreign submarines can also strike a significant portion of continental United States with nuclear weapons. To counter this, the country now spends several billion dollars annually in developing and operating anti-submarine forces. When one looks at the anti-submarine warfare problem from a military standpoint, serious dilemmas are posed. The problem of protection against a ballistic missile threat is especially serious since a large portion of the ocean is available for deployment. Continuous surveillance is required to minimize the danger of surprise attack.

Area surveillance is extremely difficult. Even if it were possible to erect barrier lines which could count and identify every submersible which passes, these would soon be lost in the vast ocean expanse on the other side of the barrier. One possible solution that might be posed is continuous tracking. If a transit through a barrier line were to occur, friendly forces might conceivably follow the potential aggressor. This tactic, however, may prove to be both technically and operationally difficult. Indeed, it is doubtful if the tactic would be of value after discernment of our intentions by other submersibles.

There is a temptation to look for a legal principle which permits the use of a barrier. The idea comes to mind that a power could prevent penetration of an *announced* barrier by military submersibles. This rule would be akin to the blockade rule, which requires both announcement and the necessary power to enforce it. This rule, however, would be a two-edged sword. It would be highly destabilizing to other free uses of the sea.

The alternatives then would appear to be to conduct intensified attempts to track or to conduct effective area surveillance. If the latter effort is undertaken another problem arises. This would be the perfection and deployment of the sensing elements. The rules for military use of the sea should not forbid installations on the ocean bottom for the detection of submarines.

Between the closing of a portion of the seas to military submarines and maintaining the freedom of the seas for both deployment and surveillance, the latter appears the more attractive course from the point of view of our defense. This choice is heavily conditioned by the fact that United States has free access to the seas and a large stake in maintaining free movement on and in them.

The case of the submarine armed with nuclear missiles is a serious consideration from the standpoint of protection of national interests. Certain policies which might favor our military and our defense systems in this respect, are: The rules should not deny freedom of the seas for deployment of strategic forces by all nations. The rules should not deny freedom of the seas for deployment of strategic detection and warning devices. Future developments of international agreements should allow use of the ocean surface, the air and space above it, and the ocean bottom for warning devices.

Tactical Naval Forces are made up of many elements including Strike aircraft and their carriers, amphibious craft, mine warfare forces, shore bombardment ships, forces for fleet defense and logistic support ships.

The use of the oceans as a base for mobile airfields for air attack against land and sea targets, as well as for ASW search planes is an important military use of freedom of surface movement on the seas. In a sense these carriers can be viewed as either strategic or tactical depending on how they are deployed and used. They must be accompanied by forces intended for their protection and logistic replenishment.

The United States has developed and practiced amphibious warfare a great deal. This form of warfare has been required by conflicts on foreign shores particularly those involving allies. This projection of force sometimes, however, can have the concomitant advantages to the United States of keeping conflicts remote from our national boundaries. This, too, is a use of the oceans as a base for the projection of infantry and armored power ashore. These forces too must be protected, and generally require air cover.

Where the military presence of these forces have been invited no legal problems are raised by their deployment. But if the territorial seas of neighboring neutrals or potential hostile powers were to be unilaterally extended so that ambiguity existed or serious deployment interference resulted then political factors would have an impact on the conduct of the military campaign. For this reason extension of sovereignty to the extent that it denies freedom of military forces is inimical to the continuation of past tactical doctrines.

Mine Warfare is another area of concern. The moored mine, though designed to be fixed in a specific location, becomes highly hazardous when set adrift by the sea, or as a result of minesweeping or minelaying attempts. This problem has already resulted in legal restrictions covering the use of moored mines, the sanitation thereof, and the prohibition of free drifting mines. Bottom mines may be actuated by magnetic, acoustic, pressure influence, or communication from shore. The United States military position regarding the legal status of mines on such areas as the continental shelf beyond the territorial sea has been that they are property belonging to the owner.

The further extension of military capability to the seabed is a clear possibility. Saturation or extended diving operations, together with vehicles, sensors, and tools, will permit broader utilization of the sea floor and may provide many military advantages. The right to deploy units on the sea floor in international waters for the purpose of inspecting for mines or other impediments to the legitimate exercise of the free seas in particular seems useful. Extension of territorial limits and/or establishment of seabed sovereignty would threaten or limit this possibility.

One other military possibility to be noted specifically is protection of those engaged in exploration of the sea. United States capital is unlikely to be risked unless it is United States policy to protect the investments against foreign or piratical invasions. This will be a Navy and/or Coast Guard mission.

In order to understand the military use of the oceans we must continually observe, measure and attempt to understand them.

Some Technological and Scientific Background to Military Use of the Sea

A knowledge of the various oceanographic conditions for the particular area involved is important if naval operations are to be successful. Forecasting techniques, developed during World War II and refined in the years since, have proven to be highly successful. In the planning stages of an amphibious landing for example, forecasts of tides, tidal currents, and surf conditions must be made. Since these conditions are affected by weather, meterologists in conjunction with oceanographers are employed.

If wind velocities and directions can be accurately forecast, these can be translated into wave heights and ultimately into heights of surf. Wave and surf forecasting can be made if measurements have been made over a wide area days and weeks in advance and in remote locations. This combined with a careful study of the hydrography of the area will enable the forecaster to predict whether the landing craft will be hampered by the presence of rip currents and inshore currents. Finally a reconnaissance of the area by frogmen will aid in establishing the presence or absence of underwater obstacles, mines, sensors, pinnacles, rocks, shoals or coral heads.

Developments in oceanography and ocean engineering are important to the overall objective in mine warfare. Since the influence which sets off the mine and the destructive force of the mine explosion are transmitted through the water, a knowledge of various water properties in necessary for intelligent employment of both mines and mine countermeasures. Until recently only areas with water depths shallower than 100 fathoms were considered to be mineable. Looking to the future the ability to work on the bottom raises the possibility that mines may be found in deeper water.

Many of the oceanographic problems related to submarine operations concern the use of sonar. For example, we have learned that changes in sound velocity can cause marked variations in detection zones and ranges. These changes cause the true position of a target and that shown by sonar to differ. Our limited knowledge about these changes makes the fire control problem more difficult than it should be. We require more understanding of the velocity and direction of sound through an entire water column.

The North Atlantic is an ocean space that requires priority attention. The Gulf Stream region along the east coast of the United States possesses many imperfectly understood phenomena that affect ASW operations. We must investigate these phenomena and exploit them intelligently in order to gain advantages for our own forces.

The Mediterranean represents a unique array of various basins of sea water. The dynamics of the Mediterranean waters may well prove to be a miniature model of the circulation and mixing that occurs within and between the great seas. As in the Western Atlantic, it is militarily desirable that we know the maximum possible concerning ocean phenomena, its geographic locations, and seasonal variations that affect ASW operations in the vital Mediterranean area.

Our knowledge of the great currents and countercurrents at the surface, bottom, and at various intermediate depths in the ocean is limited. We know that many great submerged currents do exist, but very little is known about their daily, seasonal, and annual variations. These variations affect the reliability of sonar detection and the effectiveness of anti-submarine warfare weapon systems. We also require more understanding of the relations between weather and the oceans, in order that an improvement in the accuracy of weather forecasting may result.

This required regular collections of oceanographic data in order that synoptic analyses and forecasts of oceanographic factors may be available for fleet operations, particularly anti-submarine warfare, in the same way that weather phenomena is now analyzed and forecast for air operations. For example, to support ASW forces, experimental synoptic sea surface temperature and mixed-layer depth charts are currently prepared by the Naval Oceanographic Office and Fleet Weather Central and transmitted to the Fleet via daily radio facsimile broadcasts.

The world weather maps that are now drawn at least four times daily are based primarily upon representative data from about twenty-five percent of the earth's surface (limited to land areas) and a small number of ocean stations. It is therefore advantageous to develop more ships, buoys, manned small submersibles and various instruments to measure ocean parameters, and it is desirable that we provide for the simultaneous collection of meteorological data as well.

The ability to monitor and survey the entire ocean is vital to ASW. ASW is, as practiced in World War II, a war of attrition, and in addition a strategic confrontation. It may be characterized as the closest parallel that we have in the ocean to guerrilla warfare. In order to be able to combat guerrillas, one must be able to know their environment—where the trees and ravines are—and how they can be identified in an unknown hamlet. We have the same problem in the oceans. In order to find the "guerrilla," or in this case the submarine, we must, in addition to a good understanding of the oceans, know exactly how we can best take advantage of the ocean permeability to our benefit, and how a submarine will employ the medium to avoid us. And it is our task to concentrate on the area which he is employing to successfully detect, classify, localize, and remove him as a threat. In order to cope with the strategic threat it is important to learn the scope and characteristics of his deployment.

The effectiveness of the submarine-based missile force is highly contingent on concealment, dispersion, high mobility, and very long patrol time. It is precisely for this reason that key interests of oceanography and the Navy, reflected in the development of the submarine-based strategic-missile force, have so much in common. With this relationship in mind the Navy instituted a special program of long-range research support for oceanography and intensified field studies by its own laboratories and ships.

A Remark on Arms Control

Since much of the sea is remote from population centers there are special desires and suggestions for arms control and arms limitations there. These desires and suggestions frequently have as their genesis the basis that this is an area for potential agreement and the assumption that such agreements cannot pose a material threat to national security. It has been suggested that there is some similarity between this concept and the limitations that have been imposed in Antarctica and outer space. On the other hand, in relation to general conflict management, it may prove most desirable to separate weapons from the populations and the sea could play a special role in this effort. The escalation potential of war at sea should be much less than war near civilian populations. Of course several nations already have the capacity to use the deep seas for military purposes, so that any effort to limit military uses will require the same sort of effective international control that is needed for other types of disarmament.

Some Particular Legal Interests

In the field of International Law, there have been and will continue to be special military interests in the following areas:

1. Seaward extension of territorial waters and the contiguous zone. The United States has for years followed the principle of the three-mile limit. Some other nations, for economic or other reasons, have claimed that territorial waters exist out to four, six, twelve and even two hundred miles. These claims have been resisted, albeit somewhat unsuccessfully, by the United States. The future development of this doctrine is of considerable importance to our military posture.

2. Seaward extension of jurisdiction and sovereign rights on the continental shelf. With respect to this proposal, some of you may note—what about the fact that the United States Continental Outer Shelf Lands Act of 1953 unilaterally proclaimed jurisdiction on the seabed of the continental shelf subject to the full force and effect of the Constitution and the laws pursuant thereto? Didn't this conflict with the Treaty on the Continental Shelf which limited sovereignty to exploration and exploitation? Presumptively, the Treaty which was ratified after enactment of the statute is superior to the internal legislation. In any event the act and Treaty both serve to protect private enterprise against unfair competition, theft, unsurpation of claims, and outright piracy in the exploitation of the ocean.

3. Establishment of jurisdiction and rights on the seabed of the deep ocean. We must remain alert to advances in technology in this area. For the time being, however, in the absence of clear developmental directions, perhaps our wisest course of action would be to adopt a "wait and see" attitude.

4. Vertical extension from the continental shelves and seabed. It is only natural that nations in the future will attempt to claim rights on the waters above these areas by extension from the rights of the areas themselves. This will inevitably affect freedom to operate on the high seas of the world.

5. Modifications in the law of air and space over the seas. Control of air and space over the seas is presently limited to control of the air (not space) over the territorial waters and land areas belonging to a state. Any extension of these controls would appear to violate current basic freedom of movement. Control of the high seas in a military sense depends to a great extent upon control of the air above the high seas. The United States should therefore carefully regard any proposal to restrict the free use of the air over an area that is not territorial waters, and indeed should be cautious with respect to space agreements that might impede future use of satellites in ocean surveillance.

6. Introduction of international jurisdictions in the ocean. International sovereignty over ocean bottom areas has been suggested with the view of charging fees for some uses of them. Proposals of this sort frequently look to the improvement of the underdeveloped nations. Potential benefits of such proposals must be weighed against the implications to United States security of vesting even informal control of the seabed in an international organization.

From the standpoint of the United States military capabilities, it would appear to be generally advantageous if claims of the seabed were limited to exploration and exploitation. The right of military surveillance could be endangered by permitting establishment of sovereignty or control jurisdiction, either by nations or international bodies, over the sea bottom.

It is militarily desirable to—

(1) minimize any extension of territorial seas;
(2) closely limit sovereignty over the continental shelves; and
(3) maintain freedom of the air space above the high seas.

CONCLUSION

In summary, from the viewpoint of the United States Navy, only the most gradual changes from current law of the sea appear desirable. The security of the nation rests in part on the uninhibited use of the sea lanes.

These remarks can only suggest the breadth of military interests in the oceans, and some of the complicated interactions between legal possibilities and these national security interests.

Mr. MOSHER. I have no further questions.

(Off the record.)

Mr. LENNON. The gentleman from Florida.

Mr. ROGERS. Thank you, Mr. Chairman.

Dr. Frosch, I think your presentation has given us a good rundown on where we are now. I am delighted to see you have Captain Snyder with you. I just want to say, Mr. Chairman, that Captain Snyder has been most helpful to this committee, and I think has done an outstanding job and is one of the most knowledgeable men I think in this area. I want to put it on the record, Mr. Chairman, that he has done an outstanding job in a most helpful way in advancing this whole program for the U.S. Government.

Dr. FROSCH. If I may respond for the record, I would like to comment that what you have said is only a reflection of the kind of performance he has made in the Office of the Assistant Secretary of the Navy and I have been delighted to work with him. While I am delighted that he is going to sea to a good command, I am very sorry to lose him.

Mr. LENNON. Will the gentleman yield?

Mr. ROGERS. Yes.

Mr. LENNON. I want to say to my distinguished friend I am grateful for his statement with respect to Captain Snyder. I intended, time permitting, to recognize him specifically and any remarks he would like to add to this record.

We are all grateful for your longtime concern and interest, Captain. We hate to see you leave this part of the polluted Potomac.

Mr. ROGERS. I am concerned about the deep submergence research and recovery program. Could you bring us up to date on that? I think additional funds were allocated to it. What is the progress being made?

Dr. FROSCH. I think we are essentially, in most areas of the program, on schedule in the development and in the current stages of construction. We have made some budgetary adjustments that correspond to small slippages in procurement of all the vehicles. These principally are to adjust the years in which dollars will be required. The slippages are all small, none of them exceeding several months, and we have been careful to preserve the integrity of the program in the sense that there will be no gaps in what we are doing which might actually interfere with a sensible construction program.

Mr. ROGERS. I think it is one of the most important programs not only for the Navy but for the entire world in oceanography. In other words, from the knowledge we are going to gain in operating in deep waters, I think this research done by the Government, which is a proper field for it, will spearhead advancement by industry if we do not classify too much or at least let them know a sufficient amount to go ahead and operate in deep water for the industry of this country.

Dr. Frosch. We entirely agree. One of the things we look forward to doing is using our experience in this program to help establish standards, and in fact not only standards for engineering requirements but even possibly standards in size and arrangements so there will be, we hope, in the end some compatibility among the various vehicles operated by the Government and by private industry, and so that there can be assistance and some interchangeability of personnel as well as the interchange of technology.

We hope to make not only the technology available, but make it possible for the various vehicles to work closely together.

Mr. Rogers. Because if we can develop this technique of operating in deep water, this will also give us the ability for industry to go in and occupy the deep bottoms; will it not?

Dr. Frosch. I think that is quite correct.

Here is a case where the engineering results of national security objectives and nonmilitary exploitation objectives involve essentially the same kind of technology.

Mr. Rogers. Does the *Sealab* have a connection with this; are you integrating the experiments carried on?

Dr. Frosch. The *Sealab* work, of course, has been principally aimed at man's capability both to live and to work in that environment, and we are hoping to build up to a capability to integrate human beings into certain kinds of naval activities which would involve such work. Of course, here again the human skills and capabilities we wish to improve for military reasons are also precisely the skills and capabilities that would be usable in a commercial and in an industrial sense.

Mr. Rogers. But if you develop, as I understand it, the deep submergence vessel and the technique to operate it through *Sealab*, this definitely ties in and is a great boom to industry in trying to explore the resources of the sea bottom?

Dr. Frosch. That is correct, but of course at the present time we do not see that men will be able to operate at the depth to which the vehicles will go. So there will be a joint operation of vehicles and men to some depth and beyond that depth only vehicles. Gradually we may increase the depth at which men will operate, but at the moment, certainly, we can have vehicles that will work much deeper than exposed men.

Mr. Rogers. Yes, but I presume you could place equipment on the bottom of the sea and have a transfer from the vessel to the equipment.

Dr. Frosch. Yes. We are looking at that possibility. We are also in the long run looking at the possiblity of transferring the men themselves from mobile platforms to fixed habitats and so on.

Mr. Rogers. May I ask how you feel AUTEC, the Atlantic undersea technology evaluation, is coming along?

Dr. Frosch. AUTEC is coming along very well.

As you know, all of its capabilities are not completed, but we are proceeding on a reasonable schedule to complete those that are not yet finished. The range has already proved to be of considerable value in some of our test programs.

Mr. Rogers. Do you intend in this program to allow industry to come in and use the range?

Dr. Frosch. We have been looking at that. There are two kinds of problems that we need to solve before we can do it. One is that some of the range capabilities are classified for the reason that the details of the capabilities would say too much about the things that are being tested. We need to find some way to, so to speak, sanitize range use for nonsecurity purposes.

There also may be some problem of scheduling and of untangling the priorities between the military range problems and the industrial range problems. I think we would very much like to make AUTEC and our other ranges available for non-military use, but I think we need to think about the problems involved more than we have been able to so far. And, I think, we will have to have more experience in the actual operation of the range before we completely understand how to do this. The range, of course, is still somewhere between a test status and and operating status. We are just really getting experience with it now.

Mr. ROGERS. I would be hopeful as you move into an operational basis you could try to bring in some industry use of the range. I think it would be most helpful.

Dr. FROSCH. Yes.

Mr. ROGERS. I assume from your comments that you would be opposed to the Malta Resolution or at least the Department would be opposed.

Dr. FROSCH. I think it would cause very severe problems for the Navy. It is possible that there would be other overriding national requirements that would make it necessary for us to find some way to operate under those restrictions, but it would certainly cause considerable difficulty for the Navy.

Mr. ROGERS. In classified matters, do you have any exchange at all in classified matter with other governmental departments or is this classified strictly to your own Department use?

Dr. FROSCH. Oh, no. When there is a requirement which can be identified by discussion between the departments, we can arrange and frequently do arrange for another department to have access to classified material. Generally speaking at least, the very people in other departments who need to understand what we are doing and perhaps to use the results have access to the relevant classified material.

Mr. ROGERS. Such as ESSA?

Dr. FROSCH. ESSA, Interior, NASA, AEC.

Mr. ROGERS. There is an interchange between departments?

Dr. FROSCH. Yes.

Mr. ROGERS. What is the Navy's position on the innocent passage of Russian vessels in our waters? Is this determined at Department of Defense level or at State?

Dr. FROSCH. I think it is determined by consultation between the Department of State and the Department of Defense. Our general position has been that we have stood for free use of the seas, including the right of innocent passage in defined straits that have traditionally or by agreement been straits that permitted innocent passage. We continue to take this position because every time we assess it we conclude that it is in the best interests of U.S. security to have an international situation in which the right of innocent passage through these straits is preserved for us. Part of the price of having it preserved for us has been to have it exist as an international open strait for all nations.

Mr. ROGERS. Has there been a review of our position since the Russians denied the passage of the Coast Guard vessel through the straits in the Arctic?

Dr. FROSCH. I am not aware of any formal review. I have not been involved in it.

Mr. ROGERS. Do you think there should be?

Dr. FROSCH. I think this would be a good occasion to reexamine the situation.

Mr. ROGERS. As I understand it, before a vessel comes into our ports, a Russian vessel, they obtain permission.

Dr. FROSCH. Oh, yes. That is separate from the right of innocent passage, of course.

Mr. ROGERS. Yes; I understand.

Dr. FROSCH. Yes.

Mr. ROGERS. I understand when we go by innocent passage we must obtain permission, is this true, within the territorial waters of Russia?

Dr. FROSCH. I am afraid I do not know.

Mr. ROGERS. Would you let us know that. I think it would be important. It is my understanding they require us to at least ask permission even to go through an innocent passage.

Dr. FROSCH. There are really two questions there, I think. One question is whether there is anything in international law or legal tradition that would require us to give notice, and then the second question is, if there is not do we give notice anyway?

I will try to provide an answer to both questions.

(The information follows:)

INNOCENT PASSAGE—FACTS RELATING THERETO

In response to the questions on innocent passage, the following information is provided:

The U.S. position in relation to innocent passage of foreign vessels, including those of the U.S.S.R., is formulated only after close interagency coordination rather than being determined solely by any one agency. This position is that all ships have the right of innocent passage and is predicated on customary international law, the decision of the International Court of Justice in the Corfu Channel case, and the 1958 Geneva Convention on the Territorial Sea and the Contiguous Zone. The Department of the Navy considers it to matter of vital importance to its world-wide naval operations that this position be maintained.

The U.S. did review its position on innocent passage in view of the Russian denial of the passage of two Coast Guard icebreakers on 29 August 1967. This denial of passage by the U.S.S.R. was considered to be in violation of international law and resulted in an official U.S. protest note to that effect. Upon review it was determined that it was in the best interest of the U.S. to maintain our present position based on international law rather than formulate a new policy based on violation of such law by a foreign state.

The United States does not seek permission for the passage of government vessels undertaking innocent passage through the territorial waters of any country including the Soviet Union. Clearance or permission, however, is obtained when the contemplated entry is not clearly within the rights relating to innocent passage and the foreign waters to which such rights apply.

Permission in some form or other is required before ships enter the port of any foreign country. This permission may be a blanket clearance under special agreement or it may be on a case by case basis. The U.S. and the U.S.S.R. have from time to time permitted port calls for each other's oceanographic ships, specific permission being required in each instance.

There is no consensus among maritime nations requiring notification of innocent passage through territorial waters or through straits used for international navigation. Specifically, the Territorial Sea Convention did not include a requirement of notification for passage. Further, it is not the policy of the United States to furnish notification of the innocent passage of its warships, flag, or other vessels, and it does not require notification from other states.

Mr. ROGERS. The reason I am concerned and I think there should be a review of this policy, since September 1965, I am informed the Coast Guard has sighted 262 Soviet vessels in passage within 12 miles of the Atlantic coast of Florida, for instance, and 25 vessels were observed in innocent passage in the territorial waters. It is estimated in the last 2 years over 50 Soviet vessels have passed through the territorial waters of the United States in innocent passage.

During 1966 permission was granted to 42 Soviet vessels to enter the territorial waters of the United States for various humanitarian reasons, and this year permission was granted to 13 Soviet vessels to enter territorial waters for the reasons I mentioned, humanitarian and so forth.

It seems to me if we are going to allow all of this passage through the territorial waters of the United States and to have Russia refuse a simple and innocent passage through a strait, we ought to review our policy and have an immediate change to treat them as they treat us. Would you not agree?

Dr. FROSCH. I think we ought to examine the policy.

Mr. ROGERS. Thank you very much.

Thank you, Mr. Chairman.

Mr. LENNON. The gentleman from California.

Mr. REINECKE. Dr. Frosch, the chart you show regarding the oceanographic ships is accumulative, is that right? Does this include naval vessels, commercial vessels, and educational vessels?

Dr. FROSCH. Yes, it does.

Mr. REINECKE. This is a total?

Dr. FROSCH. I am wrong. It does not include the commercial vessels.

Mr. REINECKE. Just education, institution, and naval vessels, is that correct?

Dr. FROSCH. Government vessels, that is vessels owned or operated by the Government agencies and those operated by universities supported by Federal funds. It does not include the privately supported fleet.

Mr. REINECKE. So this is all oceanographic vessels under some sort of Federal mission?

Dr. FROSCH. Under some sort of Federal ownership or funding.

Mr. REINECKE. Are you aware of any problems that have developed regarding Coast Guard regulations pertaining to oceanographic vessels?

Dr. FROSCH. I am aware that there were some problems that arose several years ago that had to do with what category of existing regulations should cover oceanographic research vessels. The difficulty, as I understand it, being that Coast Guard regulations under the statutes existing provide for two categories of people on a vessel, the category of passenger and the category of crewmen, and application of either of these categories to the research scientists who are not crewmen in the sense they actually operate the vessel and not passengers in the sense that they do operate things on the vessel led to some difficulties. I do not recall precisely what the resolution was, but it is my understanding that a kind of semispecial category was devised which has generally solved the problem. If there is a more recent difficulty, I have not been aware of it.

Mr. HANNA. If the gentleman will yield, we passed a bill on that.

Mr. REINECKE. That is right. We passed a bill that there should be special consideration for oceanographic vessels or ships on oceanographic missions on any given voyage. I have been recently notified there are still some existing problems in the interpretation of this particular law by the Coast Guard to the point that the Coast Guard even wants to approve or disapprove the oceanographic equipment installed aboard in addition to normal safety procedures which I think we are all familiar with.

You are not aware of this?

Dr. FROSCH. That has not been brought to my attention, but I consider it has now been brought to my attention and it is a legitimate problem for my committee to look into.

Mr. REINECKE. I would appreciate it very much if you would. It is a matter of ironing out some communications problems I think and some technical details, but nonetheless, it does hamper research.

Dr. FROSCH. It will be done.

(The communication follows:)

DEPARTMENT OF TRANSPORTATION,
U.S. COAST GUARD,
Washington, D.C., October 31, 1967.

Dr. ROBERT A. FROSCH,
Chairman, Committee on Marine Research, Education, and Facilities, Pentagon Building, Washington, D.C.

DEAR DR. FROSCH: I am writing in reply to your request for information concerning the nature and status of U.S. Coast Guard regulations as they apply to oceanographic research vessels.

As you know, Public Law 89–99, an act to exempt oceanographic research vessels from the application of certain vessel inspection laws, and for other purposes, was enacted on 30 July 1965. Following the passage of this legislation, the Coast Guard circulated proposed regulations in several drafts and held a series of meetings with representatives of the academic and industrial oceanographic communities which culminated in a public hearing on the proposed regulations in the fall of 1966. The comments from the public hearing have resulted in further revision of the proposed regulations. During these revisions we have been in continuous contact with the interested groups. It is anticipated that a substantial agreement can be reached in the immediate future to allow a promulgation of the Regulations for the inspection of Oceanographic Research vessels by March 1968.

In the meantime the Coast Guard is continuing to inspect oceanographic research vessels in accordance with the provisions of the Regulations for Cargo and Miscellaneous Vessels, making every effort to take into account this mission and requirements of the research vessels. Under both the current and the proposed regulations, it is Coast Guard policy that scientific equipment used in the mission of an oceanographic research vessel not require Coast Guard inspection except for certain packages such as portable quarters, vans, power packs, portable magazines, and large weight handling equipment the installation of which affects the safety of the vessel and its personnel.

The Coast Guard has long been an interested and active participant in the marine sciences. We understand the scientific nature of much of this field and are reviewing all of our actions to make certain that oceanographic research vessels are regulated to the minimum degree consistent with the level of safety at sea demand by the interests of the nation.

Sincerely yours,

W. J. SMITH,
Admiral U.S. Coast Guard, Commandant.

Mr. Reinecke. Even to the point, to give an almost facetious example, that certain hand flashlight batteries are not approved aboard oceanographic vessels, little "D" batteries used in hand-carried flashlights. It is almost inconceivable for me to believe the Coast Guard would be concerned about what kind of batteries a man buys for an oceanographic mission as long as he lights his way.

Dr. Frosch. That problem I would presume would depend on whether the light to be powered by the battery was one of the formally approved safety lights or not. If it were, it might be reasonable for the Coast Guard to set standards for the power, of course. If not, it is a matter that would have to be looked into.

Mr. Reinecke. It is my impression in this case it was not. I would appreciate your checking into that.

Dr. Frosch. We will.

Mr. Reinecke. Regarding the Malta Resolution, were you invited to appear before the Foreign Affairs Subcommittee hearing this particular matter recently?

Dr. Frosch. No; I was not.

Mr. Reinecke. Mr. Chairman, when I testified before Mr. Fascell's committee, I suggested if they had not that they should invite him to get the defense consequences of the proposed Malta resolution. Apparently this was not done.

Would it be in order for our committee staff to suggest this to the staff of the appropriate subcommittee?

Dr. Frosch. Mr. Chairman, I might just comment.

I answered your question, sir, precisely in the sense I was not invited. I do not know whether anyone else from the Department of Defense or the Navy was, but I can find out.

Mr. Reinecke. It would seem the Department of Defense, and particularly the Navy, would have a vital interest in this particular resolution and certainly your position should be expressed to that committee.

Dr. Frosch. Yes, but it might well have been regarded as an international affair and/or operating matter rather than a research or oceanographic matter per se and other officials of the Department may have appeared.

Mr. Reinecke. Would you check and notify the committee?

Dr. Frosch. Yes.

(The information follows:)

As of 13 October 1967 no Department of Defense witness had been requested to testify before the House Foreign Affairs Subcommittee on International Organizations and Movements.

Mr. Reinecke. Regarding again the Malta decision, when a matter of this type comes up, does the State Department consult with you or with other members of the Department of Defense for a position?

Dr. Frosch. Yes, it does, and in this case it has extensively. It is normal practice for any such matter that can be recognized as bearing upon national security to be sent both informally instantly, and formally as soon as possible, to the Department of Defense with a request, certainly, if it is a matter as far reaching as this one, for a formal Department of Defense position.

Mr. Reinecke. Thank you.

One further question. Was this material prepared for this hearing, or is it for general use?

Dr. Frosch. This is the most recent updating of material that we prepared, I think, in the first instance for the President's Commission and have used from time to time.

Mr. Reinecke. In your position as Director of Research for the Navy, do you feel the Navy's share of the overall marine science program is dominating the scene?

Dr. Frosch. The amount of work that we do has been determined by our national security requirements rather than by the overall national marine science needs. There is no question that the Navy has been the largest participant in the national marine sciences program both in expenditure of funds and in number of ships and men that it operates. I do not know in what sense it could be said to be dominating. I am not sure I understand.

Mr. Reinecke. I am thinking more from the administrative point of view, it being the lead agency from which all of these other nine agencies you indicated might look to for leadership or for support.

Dr. Frosch. I think the other agencies very frequently looked to us for support and for help. I do not think that we have been dominating in any case in the sense of imposing either the Navy's view of how to do things or, indeed, the Navy's techniques for doing them on anyone else. I think we have been fairly careful and reasonably successful in being a helper when asked.

Mr. Reinecke. In your opinion, do you have full disclosure of nonclassified people between your Department and the other nine?

Dr. Frosch. Oh, yes. We publish a great deal, we make documents available and data available. I think there is no major problem here except that sometimes the volume of material involved is very large.

Mr. Reinecke. It is very fine testimony. I thank you, Doctor.

Dr. Frosch. Thank you very much.

Mr. Lennon. The gentleman from California.

Mr. Hanna. Doctor, in the President's budget of 1968, $258.7 million is included, is this the amount you anticipate will be required to make the consolidation and changes in the Defense facilities?

Dr. Frosch. No., I believe it is not included in the budget, because it is regarded as primarily a matter involving the military mission of the laboratories concerned, even though they also have important roles in general marine science affairs. What would be included in this budget is the portion of those laboratories' budgets that is attributable to general marine science.

Mr. Hanna. Would I be correct in presuming from that, that the Defense's budget in marine science is substantially larger than the $258.7 million, in that it would include those projects that have direct military application?

Dr. Frosch. The problem is, of course, one of deciding what is a suitable definition of marine sciences. When we were writing a charter for the Oceanographer of the Navy, we took the first draft and discussed it with the Secretary of the Navy. He looked at the first draft and said: "Well, that is very interesting; that is an excellent definition of the Navy; but maybe we'd better restrict it some more so that it becomes an excellent definition of oceanography." We have that problem all the time.

There are many aspects, for example, of torpedo design and testing which we define as being attached to purely military matters and not attached to marine science, but which could perfectly well be defined as being marine underwater technology. There are hydrodynamic aspects and technological aspects of handling torpedoes. We have tried to attribute things that are really military rather than general marine sciences to the military area, and when we write the oceanographic budget to be reasonably strict about keeping things that are not general marine science contributions out of it.

I would certainly not say that I can be sure we have done this correctly in every instance, since to some extent it is a matter of judgment. We try to do as well as we can.

Mr. HANNA. Thank you.

And thank you, Mr. Chairman.

Mr. LENNON. Counsel?

Mr. DREWRY. Dr. Frosch, one thing that concerns me particularly is your reference to the fact that some two-thirds of oceanography in the Navy is in the unclassified territory and automatically available. What mechanism or mechanisms exist for the dissemination of this unclassified material, or what mechanism exists for making it possible for people who could be interested in it to know that it exists and is available?

Dr. FROSCH. The publication of charts and reports is one example. The unclassified charts are, of course, for public sale by the Navy and, in fact, are widely distributed and can be purchased from many outlets. The reports are of two kinds—formal scientific publication in the journals and books that are published in the scientific community which are immediately available; the publication of technical and other reports that are deposited in the Defense Documentation Center and can be obtained from the DDC by well-known procedures for unclassified materials. These are known to the academic community and to the commercial and industrial community.

We also hold a number of meetings and contribute to more general meetings in which we discuss oceanographic matters specifically. We hold, for example, annually a military oceanography meeting, all or part of which is unclassified, which has wide attendance from the community people interested in the subject. We do our best to have Navy speakers and people who have worked in the program present their work at scientific meetings, other meetings, and special meetings.

We make efforts through committees like the one I now chair to keep the other agencies informed of both the general nature and the details of the Navy's work, and these committees are quite important as information exchange organizations. And, of course, we respond to direct requests from other agencies, from academic people, and from industry, which come to the Navy by letter or by phone call or personal contact, asking if the Navy has information or data on such and such. When we can, without compromising our security position, we provide it. Sometimes, in fact, we will use such a request as an occasion for reexamining a classification policy and, if possible, for declassifying the specific information required.

Mr. DREWRY. Of course you contribute to the National Oceanographic Data Center.

Dr. FROSCH. We are a contributor to the Data Center and all of the unclassified data that fit within the category of interest to the Center are supplied to it.

Mr. DREWRY. You have NODC listed as a Federal nondefense oceanographic laboratory. But is not the Navy still pretty much running it?

Dr. FROSCH. The Navy is responsible for the administration of the Data Center, but it is really an interagency center in the sense that it is operated by a board of trustees from the various agencies. They are responsible, as an appointed group from the agencies, for the policies and operations of the Data Center. NODC is funded by: One, contributions from the various agencies, and two, by the sale of data."

Mr. DREWRY. I understand you are Chairman of the U.S. delegation to the Intergovernmental Oceanographic Commission of UNESCO meeting in Paris beginning next week.

Dr. FROSCH. Yes.

Mr. DREWRY. I wonder if you could explain for the record just what the IOC is, what it does, and any particular points of interest you expect to be raised at this upcoming meeting.

Dr. FROSCH. Yes; I would be happy to.

The IOC is a Commission under UNESCO which is responsible for international coordination in scientific matters related to oceanography and marine sciences. Its members include any member of UNESCO who signifies a desire to be a member of the IOC. There have been 55 nations that have participated during its history. It deals with all kinds of cooperative scientific problems: The interchange of data and interchange of publications; the making of provisions for direct comparison of instruments so that various peoples' data can be known to be comparable; the making of provisions for international cooperation in expeditions that explore various parts of the ocean; joint experiments; and contribution of resources of men and ships to joint explorations.

Most of the items on the agenda of the upcoming meeting deal, in fact, with the details of such exchanges and such expeditions. There has been some talk in the past year or so, and a previous proposal from the Soviets, of the IOC undertaking some attempts to write conventions that would deal with the legal aspects of these activities.

In past meetings, the United States has opposed this view. There is some opposition to it, I believe, in other organs of the United Nations. The feeling has been that the IOC has been most successful as a scientific coordinating body and that it should stick to science. It is not likely to improve its operation by undertaking major expeditions in areas other than science.

Mr. DREWRY. Just one more question, Dr. Frosch.

Under the National Science Foundation you describe the academic and educational activities and under HEW you also indicate oceanographic education fellowships and grants. Overlap is something we have worried about ever since we got into this picture and I wonder if you can define how overlap is avoided as between HEW and NSF?

Dr. FROSCH. The National Science Foundation and the Department of Health, Education, and Welfare, do, in fact, have some overlap in their statutory responsibilities for education. This overlap, however, is seldom if ever reflected in their programs. While HEW has as its mission the support and improvement of education in many fields, NSF is concerned solely with improving education in the sciences, to increase the Nation's scientific research potential. There is a continuing close liaison between HEW's Office of Education and the NSF on all educational matters pertaining to science. This liaison often results in joint support of a particular program, or in recognition by one organization that the other will have responsibility for a program or project; however, as I have said, seldom if ever does it result in a duplication of effort.

Mr. Drewry. And the educational work of NSF is a vital part of NSF's basic role?

Dr. Frosch. Yes; I think it is vital and tends to be an automatic part because of its strong connection between graduate and higher undergraduate education and research.

Mr. Drewry. Thank you very much.

Mr. Lennon. Thank you, Mr. Counsel.

I think the record of these hearings would not be complete unless we had some comments from Captain Snyder for our record and any observation you would like to make from your experience in this field before you have a change of duty station. I would like to get you on the record in these hearings right now. Make any observation you would like.

Captain Snyder. I would like to thank you, Mr. Chairman, for the kind words you have had to say. I think, after 4½ years in Washington, that it has been quite an education and I think I owe a lot of my education to the three people I have worked for, who you mentioned, Dr. Frosch who sits here of course. I am indebted to your committee for the attempts you have made to bring together a national, diversified program both within the Federal Government and within the industrial community. I have been very pleased to serve in my capacity. It has been a significant part of my education as I move along.

I truly appreciate, as all of us do, the nonparochial view that this committee has taken in trying to make everyone operate together, to cooperate and not to dominate. I think that we are well along the road of success in this field.

I just want to thank you for all of the help you have given me.

Mr. Lennon. We are grateful for your services and what they have meant to this committee.

Thank you, gentlemen, for your testimony.

Dr. Frosch. Thank you very much.

(Whereupon, the subcommittee adjourned at 11:55 a.m., subject to the call of the Chair.)

NATIONAL MARINE SCIENCES PROGRAM

THURSDAY, DECEMBER 7, 1967

House of Representatives,
Subcommittee on Oceanography of the
Committee on Merchant Marine and Fisheries,
Washington, D.C.

The subcommittee met at 10:10 a.m., pursuant to call, in room 1334, Longworth House Office Building, Hon. Alton Lennon (chairman of the subcommittee) presiding.

Mr. Lennon. The meeting will come to order.

The purpose of the hearing we are having today, and for the next several working days, scarcely needs any elaboration to the many who have been following our efforts to collaborate with and help develop the national oceanographic program under the direction of the Marine Resources and Engineering Development Act of last year, 1966.

In mid-August this particular series of hearings was initiated on the anniversary of the establishment of the National Oceanographic Council. I recall it so well. It was August 17, which happened to be the birthday of a member of the committee. The anniversary of the first meeting of the National Council, which was August 17, 1966, so that we tried to time our hearings 1 year later to begin our hearings on August 17 of this year.

Our objective then, gentlemen, as it still is, was to review the operations of the new Council, the new Commission, and all the constituent Federal agencies who are in important ways involved in the national oceanographic program.

We felt that, even though the mechanism we had created would be administered well by all involved, we should, to keep ourselves as effective partners in the team, ask all to keep us periodically advised in some detail as to the particular activities of each agency and its place in the total picture.

Back in August when we heard comprehensive testimony from the Executive Secretary of the Council, Dr. Edward Wenk—and after Labor Day when we heard from the Chairman of the Commission—we had hopes of having a more or less uninterrupted series of hearings which, within a few weeks, would have enabled us to receive testimonial reports from all the Government agencies subject to the Council's guidance for the present and contributing to the Commission's plans for the future.

We think we accomplished quite a bit.

But neither Congress nor the executive can really make things come out so neatly. Thus, either because of pressing legislative problems in our other subcommittees, or the unavailability of important Government witnesses who had conflicts with the dates when we had hoped to schedule the hearings, we had to suspend our oceanographic hearings for a time. It's the old matter of compromise—so well known in government affairs.

Now our important witnesses who were unavailable in September and early October can be with us. And on our end our urgent legislation for this session is out of the way—and we can conclude what we started back in August without any real loss in objective.

Our witness today will be Dr. Randal M. Robertson, Associate Director for Research of the National Science Foundation, to be followed by Mr. Herbert J. Waters, Assistant Administrator for War on Hunger of the Agency for International Development.

Tomorrow it will be our pleasure to hear Dr. Leon Jacobs, Deputy Assistant Secretary for Science, of the Department of Health, Education, and Welfare.

Next week, on Monday, we will hear from Dr. Robert C. Seamens, Jr., Deputy Administrator of the National Aeronautics and Space Administration. And on Tuesday, from Mr. Herman Pollack, Director of International Scientific and Technological Affairs, at the Department of State.

Now, gentlemen, it will be our pleasure to hear first from the witness Dr. Randal M. Robertson, Associate Director for Research, of the National Science Foundation. I assume, gentlemen, those of you present this morning have in front of you the statement of the doctor. If the doctor and any of his associates that he would like to have sit at the table with him will come forward, we will be happy to recognize you at this time.

I assume, Doctor, that you will probably follow your statement as you provided it for the committee. We hopefully will have some objective questions to discuss with you. We may have to tell you a question rather than ask you one, in the interest of time, so that you may proceed, sir.

STATEMENT OF DR. RANDAL M. ROBERTSON, ASSOCIATE DIRECTOR FOR RESEARCH; ACCOMPANIED BY DR. KEITH R. KELSON, DEPUTY ASSOCIATE DIRECTOR (EDUCATION); DR. HARVE J. CARLSON, DIVISION DIRECTOR FOR BIOLOGICAL AND MEDICAL SCIENCES; DR. T. O. JONES, DIVISION DIRECTOR FOR ENVIRONMENTAL SCIENCES; DANIEL HUNT, SPECIAL ASSISTANT TO THE DIRECTOR FOR MARINE SCIENCE AFFAIRS; AND CHARLES MAECHLING, JR., DEPUTY GENERAL COUNSEL; NATIONAL SCIENCE FOUNDATION

Dr. Robertson. Thank you, Mr. Chairman.

It is a pleasure to be here today, and I would like to begin by introducing several of my colleagues who have accompanied me and who will be available to answer questions which I may not be able to handle.

I would like to start on my right with Dr. Keith R. Kelson, who is the Deputy Associate Director for Education at the National Science Foundation; then Dr. Harve J. Carlson, Division Director for Biological and Medical Sciences. Dr. Carlson was for many years our member of the Interagency Committee on Oceanography.

Then Dr. T. O. Jones, Division Director for Environmental Sciences. Dr. Jones has had a long interest in the Antarctic programs and prior to taking on his present assignment was head of our Office of Antarctic Programs, that Office now being a part of the Division of Environmental Sciences.

Mr. Daniel Hunt on my left is special assistant to the Director for Marine Science Affairs, and helps especially in his work as a member of the Marine Council.

Mr. Charles Maechling, Jr., finally, is our Deputy General Counsel.

Missing today is another key member of our team in marine sciences, Mr. Robert Abel. Mr. Abel testified before your committee in September concerning our new and very important sea grant program.

I will now proceed with my statement.

Mr. LENNON. Thank you, Doctor.

Dr. ROBERTSON. I am pleased to present to you this morning a summary of the Foundation's role in marine sciences. In the intensified national effort to insure effective use of the oceans, the principal role of the National Science Foundation is to mobilize the talents of our academic institutions. These institutions must play a key role in carrying out scientific research and in training the scientists, engineers, and technicians needed to do the job.

The goal of research in oceanography is to gain a better understanding of the sea and all the objects and phenomena that occur in this portion of our world. Scientific study of the oceans involves many scientific disciplines including the basic sciences of physics, chemistry, and biology. It requires observations, experiments, and collections at sea and work in shore laboratories. Ocean scientists use instrumentation as simple as a dip net and pail and as complex as arrays of resonnance spectrometers, computers, and fleets of fully instrumented ships.

Man's exploration of the oceans has hardly begun. Until a few decades ago, the seas were an ill-understood and hostile environment. To get to sea was a major task for the scientist, since ships equipped for scientific research were scarce. Once at sea, scientists were unable to study, observe, or collect with reliability the things that were essential because the proper equipment, instrumentation, and techniques were lacking.

Many of these problems have largely been overcome. Good ships are available now, instrumentation is improving, and more scientists are eager to study the oceans. People trained for research in the ocean sciences, however, are still in short supply. This makes it imperative for much of the Nation's oceanographic research to be done by universities so that, in addition to its primary objective of gaining an improved understanding of the seas, the research work may also serve to train the new generation of oceanographers.

To place our present programs in marine sciences in proper perspective, I would like to review very briefly the early history of the Foundation's involvement in this field. Some oceanographic research was supported by the Foundation from its very start, in 1951, with earlier emphasis on marine biology rather than on physical, chemical, or geological oceanography.

These latter fields were receiving most of their support in 1951 from the Navy Department, especially from the Office of Naval Research. Fiscal year 1960 was the year when NSF first emerged as a major factor in the Nation's oceanographic programs.

In January 1959, we sent a fiscal year 1960 budget request to the Congress in which we said:

"One of the most rapidly advancing fields of modern research is oceanography. Most of the support in this field has come in the past from the Navy with additional support in the past 2 years from the International Geophysical Year program. It has become clear that a major effort of the National Science Foundation in this field is essential."

Mr. LENNON. Doctor, might I interrupt you. I notice that you have deleted from your prepared statement certain phraseology and charges and indications made on page 3. Do you intend to put all of your statement as furnished the committee in the record, or just that part that you are reading?

Dr. ROBERTSON. I am sorry. I should have explained that. I am making a few deletions in the interest of time, and I would like that part of the paragraph included in the record.

Mr. LENNON. In other words, there is one sentence here that I didn't know whether you wanted to be questioned about, and that was in the part that was deleted.

Dr. ROBERTSON. I will be glad to go back and read it.

Mr. LENNON. We will take the liberty to ask you about anything that we received in your prepared statement. Thank you. Go ahead.

Dr. ROBERTSON. I wish to include the entire statement.

Mr. LENNON. Thank you, Doctor.

Dr. ROBERTSON (reading). "Increased funds available to the Navy are being used in many cases for applied work, thus upsetting the balance between basic and applied research in the field. This can only be rectified by the development of a strong National Science Foundation program. Furthermore, the IGY programs have opened up new possibilities for cooperative international programs which will need major support."

In the same document, we also point out:

> Biological oceanography in the United States has lagged seriously behind that of other countries. One predominant reason is that adequate ocean-going research vessels have not been generally available. The least that should be done is to increase the number by two or three per year for the next three or four years.

Elsewhere, we included a line item of $2 million for a new general-purpose oceanographic research vessel. This money, augmented by reprogramed funds, grew into the *Atlantis II*, which is now the pride of the fleet at the Woods Hole Oceanographic Institution. In justifying this vessel, we said:

> One of the most underdeveloped fields of science today is oceanography, yet this field is potentially one of the most fruitful for both scientific and practical objectives. The oceans are today one of the most significant areas of unused

natural resources—a fact recognized by the number of maritime nations having aggressive research programs. Development of the resources and ultimate use and exploitation of the ocean can only be brought about through the groundwork of basic research. Today, there is not yet enough knowledge about the seas.

Beginning from this deliberately planned intensification of effort in fiscal year 1960, NSF has moved steadily ahead in support of ocean science. In that year, our total investment, including fellowships, research grants and facility grants amounted to approximately $8 million. In fiscal year 1968, our plans call for an investment of about $37 million. Attachment 1 depicts our trend in funds for oceanography from fiscal year 1960 to fiscal year 1968.

The Foundation's current program in oceanography is in three principal areas, basic research (and associated facilities), education, and the National Sea Grant program. Your committee discussed the latter with Mr. Robert Abel, head of our Office of Sea Grant Programs, on September 22, 1967. Therefore, I assume that we may omit discussion of it today. I would like to summarize our programs in the basic research and educational areas.

I might point out that in addition to these programs, we support work in scientific information under our Office of Science Information Services that relates to the marine sciences, and that our Office of International Science Activities has programs which relate to the field of marine sciences.

Our basic research is divided into the following categories:

I. Basic research project support.
    (A) Biological oceanography.
    (B) Physical oceanography.
    (C) Support of ship operations.
II. Specialized research facilities.
III. National research programs.
    (A) U.S. Antarctic research program.
    (B) Ocean sediment coring program.

Biological oceanography covers the whole range of biological phenomena in the sea, from biophysical events in cells and the comparative physiology and behavior of whole organisms to the organization of marine populations and communities. Its main focus, nowadays, is on the ocean as an ecosystem. This approach to the sea as a living system has opened up a vast new area for exploration that will ultimately give us more powerful insights into the potentialities of the sea as a source of food and other useful products.

Limnology, which is the study of lakes, is concerned with the same processes on a smaller scale in fresh water. The limnology of the Great Lakes is simply the "oceanography" of large freshwater bodies, but smaller lakes present different problems and are studied by different methods. Research programs on lakes in every State are inexpensive testing grounds for oceanographic ideas and provide marine science with a constant stream of recruits at every level. This interchange of ideas and people between sea and inland waters is a two-way affair. A large fraction of the Foundation's support for biological oceanography, and some of its support for physical and geological oceanography, is actually devoted to limnology.

Rapid development of interest in oceanography, and serious concern about our deteriorating environments, forecasts sharply increased demands on funds for biological aquatic science. In particular, it is anticipated that a series of extensive studies will be initiated in fiscal year 1969 designed to clarify some of the puzzles of productivity in natural waters. The main emphasis probably will be on estuaries. Here, as in lakes, the environmental variety is great, productivity and population densities are high, and access is relatively simple. Some of the projects will deal with pollution in estuarine waters; others will evaluate the results of modification of estuarine environments.

For the past several years, the National Science Foundation has supported two unique training and research programs for graduate students. One of the programs is centered on the west coast at Stanford University and the other on the east coast at Duke University. In each case, a fully equipped oceanographic ship operates on a year-round basis in an extensive series of research cruises. In effect, the students learn the techniques and principles of oceanographic research by undertaking full-scale projects at sea. Several hundred young scientists already have received firsthand experience aboard the RV *Te Vega* and the RV *Eastward*.

Another unique facility is embodied in the RV *Alpha Helix*, the only ship in the world designed specifically to meet the needs of marine physiological research. The *Alpha Helix* is owned and operated by the Scripps Institution of Oceanography and supported wholly by the National Science Foundation. It has completed two major expeditions, one to the great barrier reef of Australia and one to the Amazon River Basin. Approximately 120 scientists from all parts of the Nation have already participated in the *Alpha Helix* cruises.

Physical oceanography has been significantly enhanced in the past few years by advances in technology. The approach made possible by sophisticated equipment, improved buoys and floats, better ships and increased teamwork among the disciplines involved—geology, physical oceanography, electronics, chemical oceanography, and biology—has improved our ability to solve problems of currents and water masses and their effects on sediments and sediment transport, the evolution of ocean basins, the development of current systems, and the interaction of ocean and atmosphere. Many previously accepted concepts are being reexamined and refined.

Recording buoys and floats with miniaturized electronic systems for the measurement of ocean currents, temperatures, salinities, and other parameters over long periods of time make it easier to trace the major world water currents. The analytical chemical devices employed allow the oceanographer to measure these parameters continuously.

The possibility of synoptic measurements of ocean surface phenomena from aircraft and spacecraft is emerging. Radar, infrared-radiometry and multispectral analysis are now being used to determine sea state, differences in temperature, water mass boundaries, and currents. Water depths have been charted from Gemini color photographs and by use of multispectral analysis. Continuously recording reflection seismic devices now permit insight into the nature of continental margins and midocean mountain chains. Sediment coring and deep sea drilling techniques facilitate collection of rock and sediment samples from specified layers identified by geophysical techniques.

The support of ship operations is a necessary and expensive part of assisting oceanographic research. The National Science Foundation and the Office of Naval Research jointly fund the total operation of most of the 28 ships, operated by 16 universities and oceanographic institutions, which will receive Foundation support in fiscal year 1969. The Atomic Energy Commission provides partial funding, but on a limited scale, for a few of these ships.

Attachment 2 lists the names of these ships and the institutions which operate them.

At least five of these research ships are in such poor condition that maintenance costs are excessive in relation to the value of the ship. Three of the ships are converted World War II vessels, and two were built in 1927 and 1930, respectively. It is estimated that a significant portion of funds allotted to ship support will be required to cover the maintenance and high repair costs of these five ships.

Continuity of support is necessary to insure that the ships are efficiently used for research purposes. Support costs are expected to rise in accordance with general cost increases in the economy. Ship operation costs include salaries and wages for crews and marine operations staff, overhaul and alterations as well as normal maintenance and repair, fuel, food, and utilities, pilot fees, port expenses, and insurance. Funds for capital equipment, improved navigational equipment, and shipboard computers are also included.

Specialized research facilities include ship and shore facilities and equipment necessary for conducting basic research. One of the factors which makes it feasible to increase Foundation support of research in oceanography is that substantial progress has been made in the past few years toward alleviating some of the critical need for physical facilities, research equipment and oceanographic research ships at universities and oceanographic institutions.

As a result of joint efforts by the National Science Foundation and the Office of Naval Research, the research fleet and shore facilities operated by the oceanographic institutions and colleges and universities are more adequate than they were several years ago. However, there is still a need for laboratory buildings, shops, piers, wave tanks, model basins, aquaria, and controlled environment systems. In addition, many existing facilities still need modification, expansion, and modernization.

Since the existing fleet of oceanographic research ships supported by the Foundation includes ships which were not originally designed for oceanographic work, and are old and costly to operate and maintain, we are investigating the cost effectiveness of constructing flat-decked ships of the 170-foot offshore supply boat type. These ships would be outfitted with general purpose oceanographic winches and major general equipment for research but would be adaptable to the specific needs of the various laboratory groups by the installation, at appropriate times, of palletized, movable laboratory units equipped for specialized oceanographic work. Such ships, procured simultaneously, and only slightly modified from standard commercial design would provide low-cost and efficient interim replacements for some of the older research ships.

Attachment 3 lists the conversion or new construction of major oceanographic research ships that we have supported during the past several years.

Under our national research program category, the U.S. Antarctic research program has been continuing with great success over the past several years. In fiscal year 1969 we hope to introduce submersibles under the perennial sea ice in McMurdo Sound, Antarctica, in order to obtain temperatures and salinities, study the ocean floor, collect specimens, and observe seals and fish behavior. This area of permanent thick ice cover is not accessible to research ships or icebreakers.

The research ship *Eltanin* will continue multidiscipline surveys south of New Zealand and Australia to the border of the sea ice near Antarctica. In late 1969 she will begin the first Indian Ocean crossings between Australia and Africa, working south to the edge of the Antarctic ice pack. Programs will include standard meteorologic and oceanographic observations and special research projects, bottom sampling, and biological collections. Geophysical equipment on board will include a seismic profiler, a magnetometer, and a sea gravimeter.

The new wooden research trawler *Hero* will begin work in November 1968 along the Antarctic Peninsula, emphasizing marine biology and water circulation studies. Coast Guard icebreakers, now instrumented for more intensive surveys, will serve as platforms to investigate areas of heavy ice pack, guided by information from weather and navigation satellites. Sensors will be positioned near the ocean floor to record salinity and currents automatically for long periods of time.

The ocean sediment coring program, which has been in the planning stage for the past several years, will increase our knowledge of the oceanic crust of the earth by studying long cores of ocean sediments.

Many segments of the scientific community have shown a great interest in the ocean sediment coring program. The many studies which have been proposed and which require drilling in the deep oceans, including various abyssal features will help solve many major problems of the origin and history of the oceans and consequently of the entire planet.

Sedimentologists, paleontologists, mineralogists, and geochemists are participating in the selection of drilling sites and planning of the core descriptions. The core material will be made available to all qualified scientists for individual research.

Our knowledge of the structure of the earth is based primarily on studies of the 30 percent or so of the earth's crust that is above water. Little is known about that portion of the crust that is off the continental shelves. A series of studies on core samples taken at carefully selected sites on the deep ocean floor should yield considerable information.

For example, a long record of the earth's climatic history can be obtained by investigating the isotopic composition of fossil planktonic organisms contained in the sediments. Radioactive dating techniques applied to materials from the cores will serve to date the times in which the sediments were laid down. The most significant hypothesis to be tested is that of sea floor spreading and continental drift. In addition, a comparison will be possible between the actual core samples and the interpretation made by indirect geophysical means. These are but a few examples of significant research studies which will be conducted using sediment cores obtained under this program.

Core drilling in the deep ocean basins and other critical areas of the Atlantic and Pacific oceans will be carried out under a contract with the Scripps Institution of Oceanography of the University of California. A subcontract has been awarded for the operation of a drilling ship capable of drilling and retrieving core samples to depths of 2,500 feet under water up to 20,000 feet deep. It is expected that drilling will begin about July 1968. This subcontract has been funded for 18 months with an option to extend it should the scientific results so warrant.

This program is conducted as a national research program under which interested and qualified scientists and students from all institutions throughout the Nation are invited to participate and to have access to the information and material which is obtained. Funds to support the study and analysis of the information and cores will be made available to interested scientists through the Foundation's program of basic research project support.

In the area of education, the Foundation funded 41 graduate fellowships and traineeships in marine sciences in fiscal year 1966. In addition, two advanced science seminars in marine science for predoctorals and postdoctorals were supported; a college teacher program in which 63 college teachers participated during fiscal year 1966 was conducted; and a lecture series was developed by the University of Maryland for the general public which was attended by 700 persons.

The undergraduate research participation program provided 27 undergraduate students opportunities for independent study and research in the marine sciences. One example of this type of activity is the project which has been conducted by the Virginia Institute of Marine Science. Of the 46 earlier participants in this project, 40 are currently enrolled in graduate programs; 19 have earned a master's degree and one a Ph. D.

Through the undergraduate instructional scientific equipment program, improvement of courses and curriculums at colleges and universities in the marine sciences was made possible. Examples of the type of projects supported in this program are the Moss Landing Marine Laboratories jointly sponsored by five California State colleges in which an award helped to equip the laboratories in marine biology, chemical oceanography, and various field programs; and a grant to the Southampton College of Long Island University for a small boat and navigation equipment, marine biological sampling equipment, and conventional biological laboratory equipment.

In fiscal year 1966, which is the last year for which we have a complete summary available, the Division of Precollege education in

Science supported 456 individuals in programs involving marine science. The majority of these individuals were secondary school teachers attending institutes to further their knowledge of the marine sciences. None of the course development projects at the precollege level was devoted exclusively to the marine sciences, but a number included marine science. For example, at the secondary school level, the earth sciences curriculum project includes such topics as composition of sea water, ocean currents, and topography of ocean basins.

At Humboldt State College, the University of California, San Diego, and Oregon State University, projects were conducted for 126 secondary school students to study and do research in oceanography. As an example, the program at the Scripps Institution of Oceanography has been supported by NSF since 1962 and involves some 40 highly selected secondary school students who are engaged in research in marine biology for 8 weeks each summer.

The Virginia Institute of Marine Science, with NSF support, held an 8-week project in physical oceanography and marine biology in which 15 secondary schoolteachers conducted research and, under the supervision of scientists, worked on course outlines to be used in their teaching when they returned to their own schools. Similarly, a grant to Louisiana State University made possible an intensive 6-week summer course which was followed by an academic year followup and consultation sessions for 30 secondary schoolteachers.

Attachment 4 lists the categories and numbers of individuals attending NSF-supported education programs in marine sciences in fiscal year 1966.

The foregoing has summarized our oceanographic effort in basic research and education, two cornerstones of the national oceanographic program. Throughout the years, in carrying out our responsibilities in these areas, members of our staff have coordinated in detail on all programs with their counterparts in other participating Federal agencies and departments. Thus, a necessary and valuable network has been developed at the working level to assure the most efficient planning and accomplishment of objectives and to prevent duplicative effort.

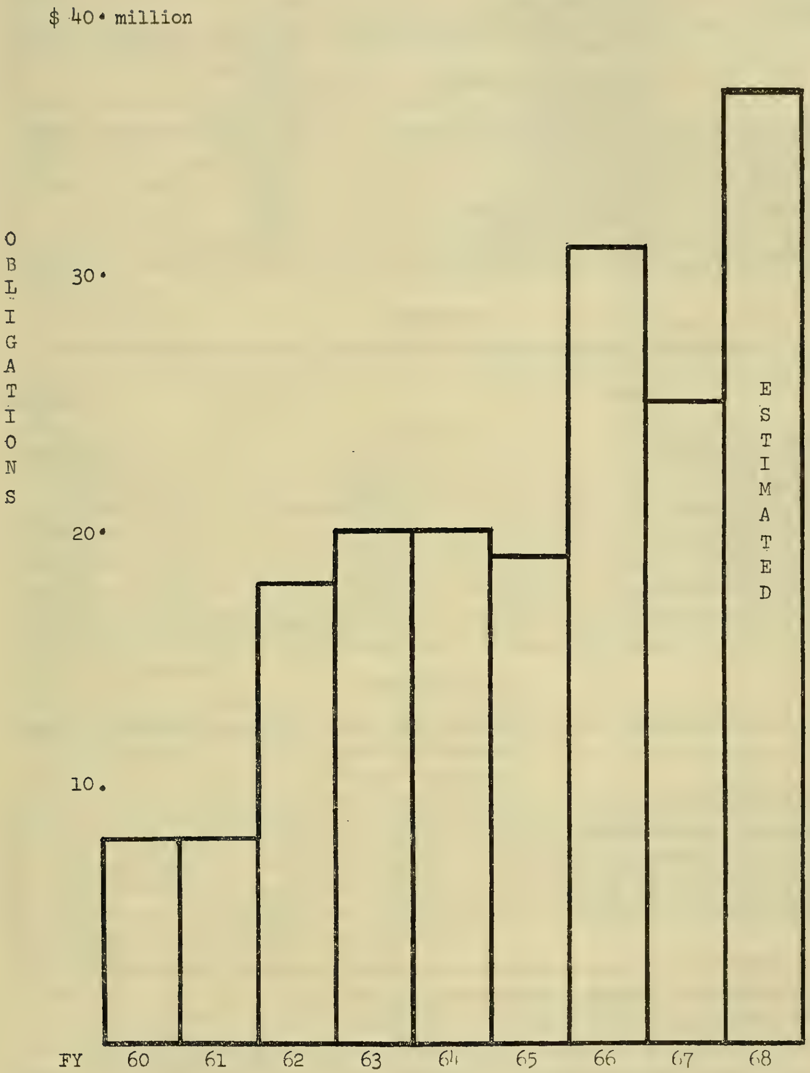
Examples of this coordination have been evident in our day-to-day coordination with the Office of Naval Research on joint ship operations and the support of basic oceanographic research; in our coordination of biological oceanography with the Department of the Interior; in our coordination of education programs with the Office of Education; and in the recently established relationships with all Federal activities that might be concerned with the sea grant program. We have worked closely with the ICO and participated as members of its committees. Today we are working closely with the Marine Council and its staff and are participating in its work.

That concludes my statement, Mr. Chairman.

(Attachments 1, 2, 3, and 4 follow:)

ATTACHMENT 1

NSF OCEANGRAPHIC TREND
(Excludes Project Mohole)



ATTACHMENT 2

NSF OPERATIONAL SUPPORT OF RESEARCH SHIPS

[Listed are major research ships (more than 90 feet) that have Foundation support for all or part of their operating and maintenance costs during the period fiscal years 1967–68]

State	Institution	Ship
Alaska	University of Alaska	Acona.
California	University of California (Santa Barbara)	Swan.
	University of California (Scripps Institution of Oceonography).	Alpha Helix, Agassiz, Argo, Horizon, Oconostota, E. B. Scripps, and Thomas Washington.
	University of Southern California	Velero IV.
	Stanford University	Te Vega.
Florida	University of Miami	Sitkin and Teritu.
Massachusetts	Woods Hole Oceanographic Institution	Chain, Crawford, Gosnold, and Atlantic II.
Michigan	University of Michigan	Inland Seas.
New York	Columbia University	Conrad and Vema.
North Carolina	Duke University	Eastward.
Oregon	Oregon State University	Yaquina.
Rhode Island	University of Rhode Island	Trident.
Texas	Texas A. & M. University	Alaminos.
Washington	University of Washington	Thomas Thompson.
Federal Government	National Science Foundation	Anton Bruun and Eltanin.

ATTACHMENT 3

NEW CONSTRUCTION AND CONVERSION OF MAJOR OCEANOGRAPHIC RESEARCH SHIPS

Institution	Name of ship	Type of support
National Science Foundation	Eltanin	Conversion.
Woods Hole Oceanographic Institution	Atlantis II	Construction.
University of Michigan	Inland Seas	Conversion.
Texas A. & M. University	Alaminos	Do.
Johns Hopkins University	Catamaran (type)	Construction.
University of Miami	Pillsbury	Conversion.
Oregon State University	Yaquina	Do.
University of Hawaii	Teritu	Do.
Stanford University	Te Vega	Do.
University of California (Scripps)	Beluga	Construction.
Duke University	Eastward	Do.
Woods Hole Oceanographic Institution	Anton Bruun (property of NSF)	Conversion.

ATTACHMENT 4

Individuals Attending NSF Supported Education Programs in Marine Science, Fiscal Year 1966

College teachers	77
Secondary schoolteachers	273
Elementary schoolteachers	12
Fellows and trainees	41
Undergraduate students	27
Secondary school students	171
General public	700
Total	1, 300

Mr. LENNON. Thank you very much, Doctor.

Mr. Mosher?

Mr. MOSHER. Mr. Chairman, I have about three questions.

Dr. Robertson, in your first paragraph you say that, "the principal role of the National Science Foundation is to mobilize the talents of our academic institutions." In using the word "principal" do you really mean almost exclusive role or what are the exceptions where you are really working outside of the academic field? Are there any exceptions?

Dr. Robertson. The National Science Foundation has a very broad charter, to support basic research and education in the sciences, and we are not limited to the support of colleges and universities. However, our policy at this time, set by the National Science Board, is to concentrate most of our support in academic institutions where most of the basic research is done, and where it also serves to train students. We do support research in a number of nonprofit institutes, some of which are closely related to the academic community, as in the case at the Woods Hole Oceanographic Institution. There are a number of other smaller nonprofit laboratories which we support.

Mr. Mosher. On page 2 you refer to the fact of the short supply of people trained for research, and on page 6 you refer to the constant stream of recruits. Is this in pretty healthy balance? Granted the short supply and the need to have more trained people, is the supply of recruits sufficient? Are you getting all you can handle? Is the academic community getting as much interest in this from young people as is good?

Dr. Robertson. There has been a very sharp increase in the last 10 years in the number of people choosing to go on to graduate work in marine sciences and related fields. I think that this flow could be larger.

Mr. Mosher. But it has increased? It is a popular field right now?

Dr. Robertson. It is a field that has been growing in popularity very considerably. We have many more Ph. D.'s awarded in ocean science today than we had 10 years ago. However, I would like to see more and better people going into the field. I think we have tremendous opportunity here and a tremendous and growing need for people at all levels of training, not only Ph. D.'s but also people with a bachelor's degree, for engineers trained in ocean-related work, and for technicians.

Mr. Mosher. So that part of your effort is to increase the flow of recruits, to encourage it?

Dr. Robertson. It is. We feel that there is a need for more people.

Mr. Mosher. I have one other question.

Several times you referred to joint efforts and to joint funding with other agencies and particularly with the Navy. What are the mechanisms by which this is accomplished? Are these bilateral efforts, or do you work through the Marine Council? Of course, you will keep the Marine Council informed, but do you just go directly to the Navy, and vice versa, to make these arrangements?

Dr. Robertson. These are bilateral or multilateral efforts where we do keep the Marine Council fully informed, as we formerly kept the ICO informed. We sit down together with the Navy and go over the oceanographic research ships, for example, and work out a pattern of support in which they provide some of the support through contracts directly with institutions such as the Woods Hole Oceanographic Institution, and we provide support through grants. We try to see that these are carefully meshed and that the needs are provided without any duplication.

Mr. Mosher. Now, have there been any occasions where the Marine Council has used the initiative that I think it is beginning to develop, used its authority to determine which agency should be the lead agency in a certain field, make a determination of whether it should be your agency or the Navy or the Department of the Interior that should go ahead and take the lead, perhaps with the cooperation of the others?

Dr. Robertson. I think the Marine Council has begun to establish a pattern of responsibilities in the field of oceanography broadly. In the basic research field, there has been no assignment of responsibility by areas of research. There we have closely coordinated programs with several agencies working in parallel.

Mr. Mosher. You haven't had any practical experience as yet with this lead agency concept where the Council determines which agency should go ahead?

Dr. Robertson. Not within the field of basic research. There have been specific agreements, for example, that one agency would take special responsibility for air-ocean interface problems. This was worked out in the Federal Council between the ICO and the Interagency Committee on Atmospheric Sciences.

Mr. Pelly. Would the gentleman yield?

Mr. Mosher. Just a second. This is usually a mutually arranged agreement rather than one that is enforced from up above? There has really been no occasion where the Council has had to say, "You are going to do it"?

Dr. Robertson. I think that is right. Their policy has been to try to work out agreement by sitting down together and discussing it, serving as a catalyst rather than a directing agency.

Mr. Mosher. I yield.

Mr. Pelly. On the point which you raised, have you read today's New York Times?

Dr. Robertson. No, I have not.

Mr. Pelly. Dr. Wenk is cited in today's New York Times as saying he does not advocate putting all marine activities under one administrative roof. The article further indicated that Dr. Wenk felt the budget must be defended piecemeal rather than as one group.

Dr. Robertson. Yes, I agree.

Mr. Mosher. I have no further questions.

Mr. Lennon. Mr. Rogers of Florida.

Mr. Rogers. Thank you, Mr. Chairman.

Dr. Robertson, I think you have given us a good rundown on your activities. Let me ask you this: Your budget is estimated for fiscal 1968 at about $38 million or $40 million.

Dr. Robertson. The present figure, as I said in my statement, is between $37 million and $38 million, which is our current best estimate of the obligation authority for marine sciences.

Mr. Rogers. How much of that amount is allocated to schools, institutions? Is all of that allocated to institutions or how is that divided?

Dr. Robertson. Practically all of the money will ultimately be distributed in grants to academic institutions and close related nonprofit institutes.

Mr. Rogers. I realize you probably won't have this with you, but would you let the committee have a breakdown as to how much money each of these institutions receives and has received, let's say, in the last 5 years from the National Science Foundation?

Dr. ROBERTSON. For work in marine sciences?

Mr. ROGERS. Yes.

Dr. ROBERTSON. We can supply that for the record.

Mr. ROGERS. Yes. I realize you don't have that with you.

(The information follows:)

NSF SUPPORT OF OCEANOGRAPHY

These tables present the support in the Marine Sciences provided by the National Science Foundation to institutions during the five-year period, Fiscal Year 1963 through 1967. Foundation support in the Marine Sciences includes research in biological and physical oceanography, ship operations, cooperative programs with Japan, ship rehabilitation and construction, laboratory construction and modification, equipment purchase, abstracting and publication services and related activities in National Research Programs which include the Antarctic Research Program, and the International Indian Ocean Expedition.

These tables do not include MOHOLE data. Traineeships and fellowships in the Marine Sciences have been excluded also, as have transfers to other federal agencies, such as payments made to the Military Sea Transport Service for operation of the Antarctic research vessel, *Eltanin.*

NSF SUPPORT OF OCEANOGRAPHY—BY INSTITUTION, FISCAL YEARS 1963-67

[In thousands of dollars]

	1963	1964	1965	1966	1967
Alabama: University of South Alabama	----------	----------	----------	22	----------
Alaska: University of Alaska	----------	----------	222	133	167
Arizona: University of Arizona	6	9	9	----------	----------
California:					
Beaudette Foundation for Biological Research	24	----------	----------	----------	----------
California Academy of Sciences	----------	36	----------	----------	178
California Department of Fish and Game	29	----------	----------	----------	----------
California Institute of Technology	85	216	321	44	51
Global Marine, Inc	----------	----------	5	80	----------
Humboldt State College	----------	----------	----------	15	----------
Los Angeles County Museum	----------	----------	2	9	----------
Mills College	----------	----------	7	----------	----------
Occidental College	----------	----------	----------	----------	18
Sacramento State College	----------	----------	----------	----------	34
San Diego Natural History Museum	----------	20	----------	----------	----------
San Fernando Valley State College	----------	12	----------	----------	----------
San Jose State College	----------	----------	128	177	----------
Stanford University	391	849	609	923	686
University of California, Berkeley	1,180	92	325	----------	26
University of California, Los Angeles	240	392	33	88	73
University of California, Riverside	----------	26	----------	----------	----------
University of California, Santa Barbara	----------	47	74	183	51
University of California, San Diego	1,394	2,222	2,473	7,570	3,935
University of California Press	----------	7	----------	----------	----------
University of the Pacific	18	----------	2	12	3
University of Southern California	298	466	1,141	258	323
Colorado: Colorado State University	----------	10	125	----------	22
Connecticut:					
University of Connecticut	----------	50	----------	----------	34
Yale University	75	50	----------	37	62
Delaware: University of Delaware	60	----------	----------	----------	----------
District of Columbia:					
American Geophysical Union	90	----------	53	30	28
Arctic Institute of North America	----------	14	----------	----------	----------
Carnegie Institution of Washington	----------	----------	----------	----------	36
Georgetown University	----------	----------	----------	----------	35
Marine Technology Society	----------	----------	34	----------	----------
National Academy of Sciences	130	71	73	20	3
National Planning Association	----------	----------	----------	125	----------
Smithsonian Institution	72	64	286	170	121
Technology Services, Inc	----------	----------	----------	5	----------
Florida:					
Cape Haze Marine Laboratory, Inc	21	----------	12	----------	13
Florida Geological Survey	----------	----------	----------	5	----------
Florida State University	162	358	102	534	330
International Oceanographic Foundation	----------	8	----------	----------	----------
Nova University	----------	----------	----------	----------	199
University of Florida	43	70	28	47	----------
University of Miami	887	2,376	1,038	1,404	1,801
University of South Florida	----------	43	3	11	20

NSF SUPPORT OF OCEANOGRAPHY—BY INSTITUTION, FISCAL YEARS 1963-67—Continued

[In thousands of dollars]

	1963	1964	1965	1966	1967
Georgia:					
Emory University	----------	----------	33	----------	----------
Georgia Institute of Technology	----------	----------	24	20	----------
University of Georgia	62	12	93	----------	171
Hawaii:					
Bishop Museum	----------	10	----------	----------	----------
University of Hawaii	249	945	1,413	803	825
Illinois:					
American Society of Zoologists	----------	----------	----------	----------	10
Chicago Natural History Museum	8	----------	----------	----------	----------
DePaul University	15	2	12	5	9
Field Museum of Natural History	----------	----------	----------	----------	5
Northwestern University	----------	----------	----------	----------	142
Southern Illinois University	----------	----------	----------	----------	8
University of Chicago	----------	----------	220	----------	----------
University of Illinois	19	----------	----------	60	10
Indiana: Purdue University	----------	----------	32	----------	----------
Kansas: University of Kansas	----------	----------	----------	----------	40
Louisiana: Tulane University	----------	----------	----------	----------	38
Maine: University of Maine	----------	----------	----------	8	15
Maryland:					
American Type Culture Collection	----------	----------	----------	----------	115
Askania-Werke	----------	----------	94	13	1
Johns Hopkins University	1,301	147	17	279	10
University of Maryland	----------	----------	49	2	----------
Massachusetts:					
Amherst College	----------	105	----------	50	31
Boston University	----------	35	10	----------	46
Harvard University	44	83	96	63	18
Marine Biological Laboratory	362	----------	264	221	56
Massachusetts Audubon Society	----------	----------	----------	----------	31
Massachusetts General Hospital	----------	----------	----------	69	----------
Massachusetts Institute of Technology	75	192	309	894	250
Northeastern University	----------	----------	18	----------	----------
Potter & McArthur, Inc	----------	----------	23	8	8
Radcliffe College	----------	----------	18	----------	----------
University of Massachusetts	18	----------	29	----------	----------
Woods Hole Oceanographic Institution	2,464	3,793	1,454	4,171	2,194
Michigan:					
Albion College	15	----------	----------	----------	----------
Michigan State University	----------	----------	----------	48	----------
University of Michigan	87	22	73	471	131
Minnesota: University of Minnesota	----------	----------	----------	127	----------
Mississippi:					
Gulf Coast Research Laboratories	99	86	25	----------	----------
Mississippi State University	----------	----------	----------	24	----------
Nebraska: University of Nebraska	----------	----------	----------	37	----------
New Hampshire:					
Dartmouth College	----------	22	----------	----------	15
University of New Hampshire	----------	----------	----------	268	19
New Jersey:					
Alpine Geophysical Associates, Inc	----------	1,346	785	1,724	519
Princeton University	----------	46	29	----------	85
Rutgers, the State University	----------	----------	19	----------	----------
New York:					
American Geographical Society	----------	49	----------	45	1
American Museum of Natural History	77	17	61	----------	241
City University of New York, Brooklyn	----------	----------	----------	----------	70
Clarkson College of Technology	----------	----------	----------	23	----------
Cold Spring Harbor Laboratory of Quantitative Biology	----------	----------	74	----------	----------
Columbia University	1,109	1,335	1,981	2,550	1,561
Cornell University	----------	----------	35	----------	----------
Haskins Laboratories, Inc	----------	----------	----------	79	----------
New York University	----------	----------	71	11	465
New York Zoological Society	8	368	23	----------	----------
State University of New York, Stony Brook	----------	----------	----------	----------	4
North Carolina:					
Duke University	362	929	436	224	584
East Carolina College	----------	----------	----------	----------	20
Wake Forest College	----------	----------	25	----------	1
Ohio:					
Antioch College	----------	----------	----------	1	----------
Bowling Green State University	7	----------	----------	----------	----------
Ohio State University	----------	----------	23	12	----------
Oklahoma: University of Tulsa	----------	----------	----------	29	----------
Oregon:					
Oregon State University	829	562	646	767	1,097
Portland State College	----------	----------	----------	----------	24
Reed College	----------	----------	----------	----------	9
University of Oregon	58	62	19	75	----------

NSF SUPPORT OF OCEANOGRAPHY—BY INSTITUTION, FISCAL YEARS 1963-67—Continued

[In thousands of dollars]

	1963	1964	1965	1966	1967
Pennsylvania:					
Academy of Natural Sciences of Philadelphia	----------	----------	----------	20	----------
Biological Abstracts Inc	----------	----------	----------	----------	22
Lehigh University	----------	----------	100	6	31
Pennsylvania State University	----------	----------	22	60	----------
University of Pittsburgh	----------	----------	----------	17	20
Rhode Island: University of Rhode Island	52	907	313	258	330
South Carolina:					
Clemson University	----------	20	----------	----------	----------
University of South Carolina	----------	----------	8	----------	----------
Texas:					
Rayflex Exploration Corp	----------	----------	67	----------	----------
Southwest Center for Advanced Studies	----------	----------	----------	----------	20
Texas A. & M. University	247	275	276	306	329
Texas Instruments	----------	15	4	----------	----------
University of Texas	12	44	32	269	21
Utah: Utah State University	----------	----------	----------	53	----------
Virginia:					
College of William & Mary	----------	----------	----------	----------	18
Old Dominion College	20	30	19	18	17
Roanoke College	----------	23	----------	----------	----------
Virginia Institute of Marine Science	14	14	15	----------	38
Washington:					
Pacific Lutheran University	----------	----------	----------	----------	6
Washington State University	----------	----------	----------	47	----------
University of Washington	1,884	519	1,454	719	1,284
Wisconsin: University of Wisconsin	14	----------	20	80	19
Puerto Rico: University of Puerto Rico	----------	12	----------	19	17
Other:					
Bermuda Biological Station for Research	119	51	335	90	40
Dalhousie University, Canada	----------	----------	----------	94	10
Naples Zoological Station, Italy	----------	----------	----------	----------	70
Universidad Nacional Autonoma de Mexico	----------	----------	32	----------	----------
University of British Columbia	----------	----------	----------	7	----------
Weizmann Institute of Science, Israel	----------	----------	40	----------	77

Mr. ROGERS. Who decides to which institutions this money should go, and to what project? Who makes that decision?

Dr. ROBERTSON. I can answer that by describing how we are organized.

Mr. ROGERS. Just quickly.

Dr. ROBERTSON. Yes.

Each of the divisions represented here by Drs. Carlson and Jones is subdivided further into sections.

In Dr. Jones' Division of Environmental Sciences, for example, there is an Oceanography Section. Proposals for basic research support and for research facilities support are submitted to us by the scientific community and are reviewed both by our staff and by outside consultants to whom the proposals are sent, and in some cases by assembled panels. We get advice from the scientific community, and then we decide within the resources available which of the projects that are proposed to us can be supported.

We have managed to support something over half of the projects which are proposed, but often have to cut their requested budget considerably below the amount they would like to have.

Mr. ROGERS. Do you put any goals to be reached, or make any general outlines of projects to be conducted?

Dr. ROBERTSON. In the basic research area, we try to support those proposals which have the highest scientific merit.

We do not try to tell the people at Woods Hole, for example, what research should be supported in the basic research area. We simply define oceanography broadly as one of our goals, and then try to support the best possible work in that field.

Mr. ROGERS. Here is what I want to know. Suppose you don't have anyone operating in an area, let's say in the biological area, that you think should be explored. You don't give any direction in this area?

Dr. ROBERTSON. We have a constant interaction with the people in the field. Our scientific staff keep watch over the area for which they are responsible, and where there are gaps, we often sit down with someone who is working in a related field and discuss that.

We try in the basic research area not to direct the work, but we do try to influence it so that all fields are covered, and so that a broad and effective program is carried on which will serve as a basis for the entire effort in exploitation of marine resources.

Mr. ROGERS. I understand the concern about not directing everything, but I am concerned about the fact that it seems that the National Science Foundation probably operates in somewhat the same manner as the National Institutes of Health, basically, so that it has been my feeling that you have not done enough directing and guidance—I realize that you cannot say, "I want you to do this, and only this"—to give more guidance in the field that can then be used for applied science.

This is one of the criticisms we have of the National Institutes of Health, as well, and it appears it exists here.

Also, I am concerned that it seems most of the institutions that you are supporting are pretty much clumped in about 12 areas or 12 States.

I would hope that you would look at new institutions more than has evidently been done. I think there is a habit, because of their competency, to go to Scripps, Woods Hole, Miami, and some others, probably as well. I would hope you would begin now to spread out the sea grant college program. I don't think the National Science Foundation has the full understanding of the thrust which Congress wants in this field, nor the importance that we attach to the sea grant college program. You should broaden the base of the program. There are seven vessels assigned to the University of California Scripps Institution of Oceanography that we are supporting in part or perhaps completely.

I am sure they are doing competent work, but we also need to broaden this base to get more people involved.

I don't think 1,300 people is a very large number to have been interested in and brought into this education program, as you list here, when 700 out of the 1,300 are the general public and 273 are secondary school teachers. As I understand, many of your programs for secondary school teachers are not exclusively devoted to marine sciences, as reported on page 16, but simply may have a few marine science courses in them.

I would hope that the National Science Foundation can exert more leadership in this area of broadening and more fully utilizing the sea grant college program as a machinery to bring in new institutions that are anxious to come in, that have people who want to do something in this area, rather than holding to the old line institutions. This would be the easy way to do it, and would be the natural thing, because there is a competency there already built up.

I hope that with this new program that the Congress has enacted you can now begin to branch out and develop on a very broad basis.

Dr. ROBERTSON. I would like to say in response that we take the sea grant program very seriously. This is a program of the greatest importance.

It broadens our charter to include applied research in marine sciences. It is a program where we will take more initiative and leadership in shaping the spectrum of activity that we support, and I hope that the program can increase at a healthy rate.

I would like also to point out in connection with developing strength in institutions that we now have three programs which are aimed at strengthening institutions in science, including marine science: the university science development program, which provides large grants to upgrade the entire science program of a university; the departmental development program, under which any science department or interdisciplinary area in an institution may be given substantial funding to help improve and strengthen its work; and a college science improvement program, primarily for 4-year colleges, where the institution may come in for help in strengthening its science programs.

All of these programs are open to proposals in the marine science field.

Mr. ROGERS. Have any been granted yet?

Dr. ROBERTSON. We have made a number of grants.

Mr. ROGERS. In the marine science field?

Perhaps you would like to furnish that for the record.

Dr. ROBERTSON. I would like to furnish that for the record, because I am not quite sure of my facts here.

Mr. ROGERS. But you don't recall any offhand?

Dr. ROBERTSON. I recall several proposals, and I am hesitating because I am not sure that the grants have been made.

Mr. ROGERS. Could you furnish that, and give us some greater detail on these three programs. I would hope without any question that marine science would play a major part in these programs, because we need this very definitely.

Dr. ROBERTSON. We hope so, too.

(The information follows:)

NATIONAL SCIENCE FOUNDATION GRANTS

No grants made to date in the Science Development Programs of the National Science Foundation have been specifically for the marine sciences. This is not to say that such science has been ignored in requests to the National Science Foundation. In the University Science Development grant to the University of Georgia, for example, there is support for marine biology which is conducted in part at Savannah River and at Sapelo Island.

The Foundation will give careful consideration to proposals involving developmental programs in the marine sciences where the supportive basic sciences are present and strong. The attached brochures describe these programs in greater detail.

(The attached brochures were placed in the files of the subcommittee. They were published by the National Science Foundation under the following titles: 1. Departmental Science Development Program; 2. University Science Development Program; and 3. College Science Improvement Program.)

Dr. ROBERTSON. In managing these programs, we leave it to the institution to decide what field or fields they will propose to strengthen. We have not limited it to any particular field, and we have asked the institutions to search their souls and come up with a program that will do them the most good in strengthening their science work.

Mr. Rogers. One last question: What is your overall budget now in the National Science Foundation, approximately?

Dr. Robertson. The overall budget is about $500 million.

Mr. Rogers. And $40 million is for marine sciences?

Dr. Robertson. That is correct.

Mr. Rogers. Do you think that is a proper relationship?

Dr. Robertson. Yes, sir. We have struggled hard with achieving the best distribution of funds we could, and I think that, in view of the state of this field, and the relation to other fields, and of our overall responsibility, this is about right.

I think what we are doing is a very important part of the total national effort, and I hope that it can all be improved and expanded across the board.

Mr. Rogers. Are there any areas where the manpower is in greater demand than in the marine science field?

Dr. Robertson. You mean areas where the need for trained people is greater?

Mr. Rogers. More critical.

Dr. Robertson. That is a hard question.

I think the need is certainly as critical in marine science as in any other field.

Mr. Rogers. Undoubtedly, and I would question whether proper allocation of funds is being effected now, with only $40 million out of a half a billion dollars going to this program.

I am not critical, because I realize what you are trying to do, and build up, but I do think that we need to give greater emphasis. This committee wants to be helpful, and the Congress wants to be helpful to you in helping to build the emphasis on marine sciences.

I hope that you will feel free to call upon the committee and furnish us information that you think can be helpful, because I do think we are not yet putting a propert emphasis on marine sciences.

I realize that it is still comparatively young in the Government program.

Mr. Pollock. Would the distinguished gentleman yield?

Mr. Rogers. I yield.

Mr. Pollock. Mr. Chairman.

I certainly would like to associate myself with your remarks and your concerns and your questions about this.

I have a feeling of frustration in this to some extent, that those institutions that are already established are the ones being utilized, and that is not enough emphasis in developing new competence and expertise in educational institutions that are desirable to be developed in the area of marine sciences.

Dr. Robertson. We are tremendously interested in this general area of science development, including marine science.

As I pointed out, we have developed these new programs over the past 5 years, which are aimed specifically in that direction.

I would like to point out that there are certain limitations in the Sea Grant Act which make it difficult to build strength through that act in institutions that don't already have major facilities, since the act provides that no funds shall be used for the construction of buildings, ships, or docks.

Mr. Lennon. Have you finished?

Mr. **Pollock.** Yes. I just asked the gentleman to yield. I will have questions later.

Mr. **Lennon.** Doctor, in that connection, you have indicated that for fiscal 1968 the funds allocated from the National Science Foundation to the field that we are discussing aggregate between $38 and $40 million, and that your total budget for the National Science Foundation for fiscal 1968 is $500 million.

Because of the interest in the matter by the members of the subcommittee, and the questions raised by the gentleman from Florida, as to the ratio of the funds allocated, it might be desirable, unless you have objections, and then we could get it from some other source, if you would put in the record not a line-by-line itemization of your half billion dollar budget, but your major categories of the $500 million budget, as it may be related to the $38 to $40 million in the field of marine sciences, which you are discussing now.

Are there any other questions?

Mr. **Pelly.** Mr. Chairman.

Mr. **Lennon.** Would that be too burdensome for you to do that?

Dr. **Robertson.** No, sir. We can do that.

I would like to point out in this general connection that much of our work in other fields of science, including physics, chemistry, and biology, supports our entire effort in marine science, although it is not listed as oceanography.

We could not get ahead in oceanography unless we had people working in these supporting fields, so that in the broadest sense, if our only objective was advancement in oceanography, we would still want to support a lot of work in biology, mathematics, physics, and chemistry, which necessarily undergirds the oceanographic work itself.

Mr. **Lennon.** This subcommittee is called on to answer inquiries from the members of the full committee on this subject matter. If we had such a breakdown, and a summary of what you have just said following that breakdown, we could then answer the questions that come to us not only from members of the full committee to the members of the subcommittee, but from other Members of Congress.

I think it would be helpful to all of us.

(The information follows:)

DISTRIBUTION OF NSF ESTIMATED FISCAL YEAR 1968 FUNDS FOR GRANTS AND CONTRACTS IN MARINE SCIENCES, AS RELATED TO THE TOTAL NSF BUDGET

[In millions of dollars]

	Total NSF budget	Marine sciences portion
Basic research project support	172.0	19.2
Specialized research facilities and equipment	18.5	4.8
National research programs	15.8	7.5
National research centers	30.2	
National sea-grant program	4.0	4.0
Computing activities in research and education	20.9	
Institutional support for science	85.0	0.5
Science education support	125.9	1.4
Science information activities	13.5	0.5
International cooperative science activities	2.0	0.1
Planning and policy studies	2.5	
Program development and management	15.9	
Total	506.2	38.0

Mr. Lennon. Now, the gentleman from Washington.

Mr. Pelly. Thank you, Mr. Chairman.

Dr. Robertson, I am curious about the shortage of trained manpower to which my colleague, Mr. Rogers, referred. Is it actually increasing or diminishing? What is the trend?

Dr. Robertson. The supply has been increasing. The demand has been increasing, too, as this program has been stimulated. I don't think that the supply is catching up with the demand.

I might ask Dr. Kelson, who represents our education divisions, whether he would like to comment on this point of supply and demand in the field.

Dr. Kelson. Mr. Chairman, I would like to make a comment on that matter, and one other, if I may. I should like to refer briefly to the estimate of $38 million to $40 million for marine sciences—oceanographic work—in our budget.

With respect to the education programs of the Foundation per se, exclusive of those under the Sea Grant Act, this is really very much an estimate, because we do not program money in education explicitly for fields. We program it by types of activity, such as fellowships.

In large measure, therefore, the amount that we can invest in education is conditioned by the nature and number of the proposals that we receive.

I think it is honest to say that we have made it very clear to the academic world at large that we have a very special interest in receiving proposals for projects of an education nature in the oceanographic sciences.

Short of actually in a sense going out and employing people to do some specific thing that we want done, we have to move rather slowly in this area.

I could say, however, that the record shows rather clearly over the years our quite open and express interest in the marine sciences, an interest which precedes the Sea Grant Act. It is producing results, but perhaps not as fast as it could.

With respect to supply and demand of manpower, one sees in this and many related fields a very interesting phenomenon.

The demand for manpower is very frequently in our society determined in large measure by governmental programs and interests. A change, a marked increase in the funds throughout the entire Government for marine sciences creates a great deal of opportunity for employment.

The production of people to fill these positions lags in some degree. Therefore, when one is attempting to predict supply and demand, one is also having to take into account the total Federal budget and to what end it is being directed.

It is also true, however, to say that the increased support for the marine sciences collectively has moved slightly faster than the training of people for the field. The production of people in this area is increasing, but not at quite the same tempo.

This in part is due to the fact that this Nation is now beginning to support the kind of work that is, per man, relatively more expensive, so that one would not necessarily expect the same ratio of dollars to people.

Nonetheless, they are moving somewhat out of scale.

Mr. PELLY. That certainly gives me a good answer to my inquiry.

I was rather amazed to return to my district, which is in Seattle, and to find that a junior or community college was training technical people in oceanography. It would seem that, if this were a broadening out in the educational field to that level, then we should be meeting the needs of the scientific community. However, apparently we are not catching up with the demand since the programs are just now starting.

Dr. KELSON. Mr. Chairman, could I make one more observation that may be of interest to the committee?

I have the pleasure of serving at least for now as the chairman of the Marine Council's Panel on Education and Manpower. That panel met most recently only yesterday, and the primary matter under discussion was how do you measure the demand function. It is a very difficult one.

Directly under the auspices of the Marine Council itself, this venture is starting. I hope that it will produce some of the answers of interest to this committee, as well as to the Foundation.

Mr. PELLY. The Government policy as far as space is concerned, where the programs are so huge and vast, has been to counteract drained off manpower by grants to educational institutions, enriching the whole field, and enabling private industry to get the engineers and other technical people that it needs. I surmise that such an approach is somewhat along the line which you have indicated.

Dr. KELSON. Yes, sir. One of the problems that one gets into in this sort of situation is essentially as follows: Let us assume for the moment that a primary, perhaps the primary employer of marine science personnel is the Federal Government.

One way of getting a look at this shortage problem, if there is one, is to, in effect, quiz the Federal Government's own agencies as to where they stand in their manpower needs in this area.

I suspect that the panel of the Council concerned with these matters is going to do just that although with a certain amount of diffidence. Government agencies, as well as non-Government agencies, get questionnaired quite a bit, and one does not initiate another round of questionnaires without making sure that the results are really needed.

But I think that the best place to start to get a handle on this quantitatively is within the Government's own family.

Mr. PELLY. With further reference to Mr. Rogers' questions and his interest in seeing that the whole base is broadened, I recall that a previous witness in these hearings furnished a list of the various educational institutions which were applying or had applied for Government grants. I found missing from that list a community college which I knew to be very much interested. I, therefore, thought it strange that it did not submit a proposal. However, I later learned that its proposal had been coordinated through the major educational institution in my district, the University of Washington.

So that consequently, because of such local coordination, the program may be much broader than appears on the surface.

I thoroughly approve of cutting down required trips by various educational institutions to Washington and all the work and cost that goes into processing applications by coordination at the local level. It seems to me that such an approach could simplify the work of the National Science Foundation and cut down costs.

Mr. ROGERS. Would the gentleman yield?

Mr. PELLY. Yes.

Mr. ROGERS. This probably would be a good idea, but I would question whether that is being done now.

For instance, I do not think the University of Miami in our State coordinates for everybody else.

Mr. PELLY. It is being done in my area. It is working through the University of Washington.

Mr. ROGERS. Money is given through the National Science Foundation?

Mr. PELLY. I don't think they have any money. I think their application has gone in.

Mr. ROGERS. I don't think they are getting any money.

Mr. PELLY. However, it avoids duplication and provides a pattern. I have taken too much time, Mr. Chairman.

Mr. LENNON. The gentleman from Virginia.

Mr. DOWNING. Thank you, Mr. Chairman.

That was a very fine statement, Dr. Robertson, and I am very proud that you made reference to the Virginia Institute of Marine Science, with which I am familiar.

They do excellent work down there, and have had some success.

Doctor, I have one simple, basic question to ask you. Many of us are interested in oceanography, and when we have an opportunity to speak to young people, we talk about this tremendous potential which this field has for them. Some of them say, "I don't know much about oceanography. How do I get started? How do I get into it?"

This is a high school student. What would be your answer?

Dr. ROBERTSON. I think it depends on what their ultimate goal is, of course.

Mr. DOWNING. At this point, too, I am an expert, every time a boy asks me that question.

Dr. ROBERTSON. Most people who become professional oceanographers in the scientific sense take a Ph. D. in oceanography after graduating from college with a major in some other field.

There are not many institutions which provide undergraduate majors in ocean science, so that many people who ultimately go into oceanographic science start in chemistry or geology or geophysics or biology, one of the fields which are fundamental to oceanography, and then go on in graduate work to do research in oceanography itself.

Now, a few institutions do give undergraduate degrees in ocean science, and of course there are training courses for people who want to stop short of an undergraduate degree, who want to become skilled technicians, for example, and the junior colleges and technical institutes are very valuable there.

Does that answer the question?

Mr. DOWNING. No.

First of all, you have to visualize this young person. "Where can I find out something about oceanography?"

Mr. LENNON. Write to his Congressman.

Mr. Downing. Write to his Congressman, the chairman says.

Dr. Robertson. One object of our courses for secondary school teachers is to inspire them with interest in this field, and also to give them some knowledge of how to guide students. We are trying to introduce some aspects of oceanography at the secondary school level, both by acquainting the teachers with the field and by introducing ocean science into some aspect of the science curriculum in the secondary schools.

Usually a young man is inspired by a combination of an interest in science and an interest in the sea. The sea attracts him as he swims in it, or sails on it. He begins to visualize a goal in life of working on some aspect of the sea.

If he keeps that goal before him through college, he may do very little actually with regard to the ocean, but he is doing chemistry, with a view toward ending up as a chemical oceanographer.

When he gets to graduate school, he perhaps enters into that field, participates in cruises of the oceanographic ships, and so on.

I think it is important that he be inspired early, and helped to continue this interest at all stages. Having things going on in oceanography which he can see, having people involved in the field who can lead and guide him is important for the young man.

Mr. Karth. Would the gentleman yield there?

Mr. Downing. Yes.

Mr. Karth. Doctor, doesn't the National Science Foundation fund at all, undergraduate work for some interested students, such as my colleague is asking about, in some universities around the country?

Dr. Robertson. Yes.

Mr. Karth. Then the answer, I suppose, is to write to you and ask how they might qualify for undergraduate funds?

Dr. Robertson. Yes. We are ready to help anyone who is interested in this field.

Some of our modes of support, as I mentioned in my statement, include provision to undergraduate colleges of research or educational equipment in this field.

We also have undergraduate research participation programs in which we provide funds to the teacher so that undergraduate students can participate in a beginning way in some research experiences.

We have a number of programs of this kind, which will help inspire people to work in this and other scientific fields.

Mr. Lennon. Will the gentleman yield to me specifically on this question at this point, for my understanding?

Doctor, on page 16, in the last sentence, you refer specifically and categorically to the work you are doing at the secondary school level, which of course would be the high school student.

Dr. Robertson. Right.

Mr. Lennon. Then you go on to say that, "* * * the earth sciences curriculum project"—which reaches, so you say, the secondary or high school students—"includes such topics as composition of sea water, ocean currents, and topography of ocean basins."

Will you illustrate or demonstrate what the earth sciences curriculum project is, and what secondary schools it is involved in under your sponsorship?

Dr. ROBERTSON. I would like very much to turn to Dr. Kelson for that.

Mr. LENNON. That seems to be the way to understand this question.

If it would help you any, we would be glad if you move another chair to the table.

Let's find out what the earth sciences curriculum project is that is sponsored by the National Science Foundation, what secondary public schools it is now available in, how do you get into this program, and who finances it, and what does it cost?

Dr. KELSON. Beginning in 1957, the Foundation undertook an activity which it calls course content improvement, directed primarily but later not exclusively to the secondary school level.

The assumption behind this program of the Foundation was that the curriculum materials, the courses and textbooks that were so frequently available and used in the high schools were simply not adequately reflective of man's knowledge and interests today.

Traditionally, textbooks at these levels have been written by other than the foremost scientists and scholars in the field.

We set up a program in which a group of scientists working together with thoroughly experienced teachers and psychologists could review the state of knowledge in their particular field—such as chemistry, physics, and whatnot—and elicit from that the most important things to start teaching at the high school. Then, again with the help of a team of teachers, they could make the material pedagogically sound and couch it in ways such that the student could grasp it.

We insist that the groups developing these materials—we could call them the collective authors, which is what they are—work independent of us, because we do not want the Government dictating the content of textbooks.

The first of these major projects was the so-called Physical Sciences Study Committee, which produced a course and all of the ancillary teaching materials, including learning materials for the teacher in physics, to be used at the high school level.

That program has become, frankly, one of our favorites. It has an enormous influence.

One of the major projects in that program now is the earth sciences curriculum study. It is not completed. As parts are completed, they are actually becoming commercially available, and any institution, any school, may adopt these materials and use them.

Mr. LENNON. Right at that point, Doctor, to nail this thing down, you say that during fiscal 1966, 171 secondary school students participated in the earth sciences curriculum project. Now tell me what public schools they were, and where, and how many students of this category that you enumerated were in each of these schools.

We have to nail this thing down so that we will know what to tell our high school students.

You say that you have this program. You say that you are moving in this direction. You are saying that in 1966, 171 secondary school students took advantage of it.

Tell us where they were, please, for the record.

Dr. KELSON. I am sorry, sir. I have inadvertently linked two quite different things.

Mr. LENNON. That is all right. Maybe you can delineate and differentiate.

Dr. KELSON. Let me refer to the 171 students. These are not students who are studying the so-called earth sciences curriculum materials. These are 171 students who were actually studying in colleges and universities, or marine laboratories.

Mr. LENNON. When you refer to secondary school students, here in Washington they have the elementary and secondary school system. The secondary school system under your definition does not include what we would usually call the high school level?

Dr. KELSON. It is synonymous with the high school, sir.

Mr. LENNON. Where were the 171 secondary school students?

Dr. KELSON. Drawn from all over the United States. Each applied as an individual to a project which we have supported explicitly in the marine sciences.

Mr. LENNON. What you are telling the gentleman from Virginia is that when a high school student approaches him, you are suggesting that he write to the National Science Foundation to say, "How can I qualify for secondary education relating to the marine sciences," and then you would answer and tell him how. Right?

Dr. KELSON. Yes, sir. We could help him on this. But let me illustrate.

Each year, a number of research oriented people, research-capable people in the sciences, write to the Foundation and send us a proposal which says in substance, "We would like to select five, 10, 15, 20 high school students to come and study under our tutelage and do research in the following field or fields during the summer. Will you give us a grant for that activity?"

They set forth their budgets and plans in their proposals. We support as many of those as we can, choosing, hopefully, the best.

When those grants are made to the institution, that institution with funds provided by us, sends out an announcement that it is offering the program, and advising students how and where to apply.

We in addition send an announcement to every high school in the United States, saying where every one of these projects is, so that, in theory at any rate, every high school student in the United States knows where every one of these projects is, and may apply as an individual.

Mr. LENNON. Will you furnish for the record the bulletins that went out during the year 1966 and 1967 to the high schools of the country, in which they were told at what university they were sponsoring a symposium or forum in the summer for these high school students?

Dr. KELSON. We should be pleased to do so.

Mr. LENNON. That will somewhat answer it.

(The brochures furnished were placed in the files of the subcommittee. They were published by the National Science Foundation under titles of:

(*a*) Directory, Science Training Programs for High Ability Secondary School Students, Summer 1967—E66–P–29.

(*b*) Science Training Programs for High Ability Secondary School Students, Summer 1966–E65–D–11.)

Dr. KELSON. May I make an observation directly relevant to your question?

We have given a grant in the past to the National Academy of Sciences National Research Council to permit a group working under their auspices to draw up a pamphlet about what the marine sciences are, what oceanography is, how you get into it, and what people in these fields do.

Mr. Downing. You say you publish those?

Dr. Kelson. We gave the grant to the Academy, which distributed it to the counseling offices of high schools throughout the United States and to others upon request.

In addition, the Marine Council has now prepared a new, much more up-to-date one, and are mailing these out upon request.

I was told yesterday that they had already mailed something in the order of 20,000 of them.

Mr. Lennon. It would be so helpful if both the National Council and the National Science Foundation would furnish a few of those copies to this committee, so that when other Members of Congress approach us and say, "Congressman Downing, I have a young high school student who wants to know where and how and when," we can send them one.

We get about as many inquiries, sir, as anybody else does on every subject.

Dr. Kelson. I am sure you do, and I will see what I can do to get the copies of the Marine Council material to you.

Mr. Lennon. Furnish it to the staff of the committee, and we will know where we can get it to furnish to our constituents.

Mr. Downing. I have one further question.

Mr. Lennon. Yes. I did not mean to interrupt.

Mr. Downing. I believe you have something on this question.

Is there actually a job opportunity in the field of oceanography for the fellow who graduates with his degree in oceanography or engineering? Is there a job opportunity for that type of person?

Dr. Kelson. One of the difficulties that I have, and I am not trying to evade answering, is implied in the phrase "in oceanography, because oceanography is really a place that you study rather than a specific field.

There are a great many opportunities for study and work of all kinds related directly to oceanography, and the marine sciences, ranging all the way from the winch operator on a vessel to a very high caliber research scientist who may be a chemist, engineer, geologist, or biologist.

One of the principal job opportunities for the top caliber person is right back in academic life, where they are trying to build faculties to produce more of their kind, and also to do research.

College and universities need these people, and there are many opportunities.

Mr. Downing. Thank you very much.

Thank you, Mr. Chairman.

Mr. Lennon. The gentleman from Alabama.

Mr. Edwards. Thank you, Mr. Chairman.

I have just one or two questions.

I am concerned, as all members of this committee are, about the general coordination between the Federal agencies in the overall oceanographic program.

You mention in your statement as an aside, referring to your Science Information Office or some agency within your organization that accumulates scientific information.

Did I understand you correctly?

Dr. ROBERTSON. Yes, sir. We have an Office of Science Information Services, which has as a major responsibility to see to it that scientific information is made adequately available to all.

Mr. EDWARDS. Then recently, when we had our other hearings, the Smithsonian Institution had a witness here who testified that as he understood the position of the Smithsonian in this overall picture, its primary duty was to assimilate all of the scientific information, so that there would be one repository for all to use.

My question, then, is this: Is there any duplication between what the Smithsonian is doing, and what you are talking about? Is there any conflict that could be resolved in the direction of efficiency, so that there would in fact be one repository, and finally, is that something that should be a sought-after goal?

Dr. ROBERTSON. First of all, I would like to say that the Marine Council is taking an active interest in this particular problem, in the area of marine sciences.

There exists a National Oceanographic Data Center, whose object is to be a central repository for data about the oceans.

We work very closely with the Smithsonian Institution in many fields. In fact, the Smithsonian Institution operates a Science Information Exchange which is a systematic listing of all scientific projects being supported by the Government, classified according to the field being supported.

We fund this Exchange by transfer of funds from the National Science Foundation to the Smithsonian Institution, so that we are very close in our relationship with them in this field.

Mr. EDWARDS. But you don't feel that there is any problem or any duplication of effort involved here?

Dr. ROBERTSON. No, sir.

Mr. EDWARDS. Thank you, Mr. Chairman.

Mr. LENNON. The gentleman from New York, Mr. Dow.

Mr. DOW. Thank you.

Dr. Robertson, it is very good to have you here before the committee.

I think I might make just one comment, and that is that I think we ought to reflect on the fact that the space program is running on the order of $5 billion a year, and here we are talking of less than $40 million for the ocean scientific portion, and the oceanographic program, and yet there are countless voices that are always telling us that oceanography and the exploration of the seas is equally important with exploration of space.

Of course, I am not attempting to focus any blame on you people here, because you have a certain assignment in this thing, and a certain area where you can operate, and a certain amount of resources.

But I do think that in general all of us ought to ponder that relationship a little bit, because it is somewhat farfetched, in light of the importance that is attached to oceanographic research.

I think further that this may explain a little bit why some of us have an impression that this program is a kind of scattered program.

It does not have the impact of a big, massive, national effort that is directed, we will say, in a creative and a systematic fashion against the whole challenge of oceanography.

I get the impression here that a lot of this develops because individuals or institutions here and there come up from the bottom, so to speak, bubble to the surface with an idea or appeal for a project, and this somewhat guides the program.

I could be wrong in all this, but this is an impression, and I think it is only fair to state the impression that I have here, and I wonder if you would care to comment on that.

Dr. ROBERTSON. I would not like to try to compare the space program and our marine science program.

The space program has to be more expensive, because of the cost of getting vehicles into orbit and beyond.

I believe that we are at a point in the science and technology of the oceans where we can take major technological steps which will be very expensive, and which will mean a substantial increase in the total investment in this field.

I think we are just at the beginning of major technological breakthroughs.

Now, we think of ourselves as having an important part in a combined effort with other Government agencies. We have a role. It is an important one. ESSA has a role. The Navy has an extremely important role.

The Council, through its broad coordinating authority—and this is underlined by the fact that the Vice President is Chairman, and that Cabinet level people are members—can, I believe, weld this program into an integrated national effort.

We are waiting for an analysis of the situation by the Marine Science Commission, under Dr. Stratton. I am sure he will have some words of wisdom for us as to both the program and the organization necessary to do the job, and I think everyone will pay a lot of attention to that report when it comes forth.

Mr. DOW. Thank you.

I have one other question, Dr. Robertson.

I understand that my own State of New York is planning some kind of activity in oceanographic research. At least I hear that, and I judge that it is not in a minor scale, but fairly substantial.

Would you care to comment on the relationship of that effort to the work of the National Science Foundation in oceanography?

Dr. ROBERTSON. Well, we have had a number of discussions with individuals from New York State, both in connection with basic research and education, and in connection with the plans that are shaping up there for the sea-grant programs.

New York is a very important maritime State, and we are expecting great things.

Mr. DOW. Thank you.

That is all, Mr. Chairman.

Mr. LENNON. Mr. Pollock.

Mr. POLLOCK. Thank you, Mr. Chairman.

I certainly would like to thank both of you gentlemen for your contribution this morning. It has been very educational.

I think, Mr. Chairman, a number of the important questions I had have been answered. If I can be specific and a little parochial for a minute, I am concerned about where we go in oceanography in Alaska.

Here we have a place that has something like 41 percent of all the estuaries, 54 percent of the coastline, and 64 percent of the Continental Shelf. We are very interested as a people in getting sea-grant college programs going.

I understand that in the sea-grant college program the funds cannot be used to build the facilities or the vessels or the docks.

My question is this, and I am sure Mr. Rogers has the same concern: In a lot of States, how do we launch ourselves into this particular field?

I am thinking now of secondary education students. How do they go to these NSF-supported education programs in the marine science field? Do they just do it by seeing a brochure that has been sent to the school? Is this it?

You say one has been sent to apparently each of the high schools in the Nation, and it is necessary then for them to convey this, I presume, to the students.

Dr. Kelson. Mr. Pollock, let me try to reply by saying that in the education area, and to some extent in the research area, the Foundation has two quite different types of programs.

One is the kind of program where an individual, as an individual be he or she a high school student, an undergraduate or teacher, may apply to some particular program of interest to him.

That is the kind of program that is oriented to the need and aspirations of an individual.

We have another kind of program, and there are several different types, where it is the institution itself which becomes in effect the beneficiary of the Federal funds.

The education programs are most notably those of two types. One is our relatively new college science improvement program, which Dr. Robertson mentioned. In that program we have come close to, but not specifically limited eligibility to, the smaller 4-year institutions.

The institute can say, "Here is an area of our own undergraduate instructional program which needs improvement, and here are plans for doing it."

We have been a little disappointed, but not surprised—and the program is really very young—that none, so far, is in the marine sciences.

Another type is directed primarily to the secondary school. This is a program in which a school district or districts can say something like this: "We have reached the point where we would now like to alter our entire program in mathematics"—marine science could be also included—"but in order to do this we need professional help on what the program ought to be like that is also consistent with the needs and interests of our school district. Then, having determined this, we are going to need help to make sure that our teachers know how to teach the program that has been developed."

The Foundation does support a program called the cooperative college-school program, in which we support precisely this kind of activity.

Mr. Pollock. Supporting training of teachers?

Dr. KELSON. It is the support of a cooperative program between a group of, typically, college faculty, specialists, and a school district, public or private, in helping that school district with its own program. The help that we can provide can and usually does consist of funds to provide the professional assistance for helping the school system with the design of its program and the retraining of its teachers to teach that program.

Mr. POLLOCK. I noticed in the table on the back page of the statement by Dr. Robertson that there was a number of 700 people of the general public who were included in the individuals attending the NSF-supported educational programs.

Would you address your attention to that?

Dr. KELSON. Yes, sir.

A group at the University of Maryland was especially interested in the marine oceanographic sciences. They thought it would be a very useful thing to try to have one or more of their number who is a specialist in this field develop a set of public lectures to try to expose some part of the general public to what the marine sciences really were. To the extent that some funds were needed to try that, we supplied them.

It was explicitly a set of public lectures. It was not an educational program that the public might have happened to come in to.

Mr. POLLOCK. It has been completed?

Dr. KELSON. We are not, so far as I can recall, currently supporting the activity.

We are willing to support this kind of activity, and do, in other fields as well. To the best of my knowledge, we are not at the moment supporting a lecture series in oceanography at this time.

Mr. POLLOCK. Doctor, I have one other question.

Earlier, when the gentleman from Virginia asked about Government requirements, you alluded to this. Are you today, or is anyone in the Government projecting Government manpower requirements in the field of oceanography?

Suppose we get scholastic competence and educational competence all over the country and get a vast supply of scientists who become qualified in the field of oceanography. Is there a place other than in the field of education for them to go? Do you know what the requirements will be? Have you projected them for 10 or 15 or 20 years?

Dr. KELSON. No, sir. The committee to which I referred is beginning to look at this. Yesterday it had its second meeting. It is very new.

Mr. POLLOCK. I see.

Dr. KELSON. To the best of my knowledge, and I could be in error, there is now not going on throughout the Government a sophisticated look at its own manpower requirements in this area.

Some agencies unquestionably are looking at their own situations.

I might add just from the experience in my own agency, that it is a very difficult thing to predict your own requirements, because your requirements in fact eventually become tailored to your financial capacity.

Mr. POLLOCK. Just one more thing, Mr. Chairman.

Do you have any program now, or any plan for a program, to sell your product in the schools of the country?

I am thinking in terms of public relations, of educational film, or whatever, in the high schools and colleges.

Dr. Kelson. Let me take a rhetorical exception to your question, or a point implied in it.

It is not our product. This is the key to our activity in this area. We merely provide the funds, and it is the professional people, the educators, the scientists, that design the product.

The matter you raise is one of great concern to us, because a group of people of very high level abilities—and I include in that description practical teachers—who have devoted 1, 2, 3, 5 years of hard professional effort to a course of materials in which they have a deep conviction, also quite naturally tend to become salesmen of it.

In the past, we have not permitted our funds to be used to advertise or sell or advocate the adoption of these products. Our position has been that if they are good, they should be accepted on their educational or scientific merits.

A problem has been growing, however, and it is in substance this: To illustrate, let me for a moment turn to a field a little peripheral to this committee's interest, the so-called new math. Much of the so-called new math we have supported.

The new math is not new math at all. It is a different mixture of mathematics and to teach it requires quite different pedagogy and skills and techniques.

One cannot assume that the teachers, skilled as they may be, and experienced as they may be, in classroom procedures or other kinds of materials, can automatically handle these new materials well.

There has developed quite a gap between the availability of the materials and the capacity of teachers to use them to maximum advantage.

We have now said to all of the groups who have developed these materials to the point where they are commercially available, "We are now willing to provide funds to you if you really want to help the teachers know how to handle your materials well."

We have reasoned, perhaps belatedly, that if one of the difficulties in getting the materials taught well is the fact that teachers don't really understand how to use them, then perhaps the people who ought to help the teachers are those who developed the materials. We are quite conscious of running some risk of criticism—and we will get it—to the effect that, "You not only subsidized the writing of the textbooks, but now you are subsidizing the training of teachers explicitly to handle those textbooks."

The authors and publishers of other textbooks do not look upon this circumstance with great pleasure, of course, but we think that, with the taxpayer having invested through the Foundation thus far a number of millions of dollars in the development of these materials, we ought to—indeed we perhaps are even morally obligated—to take the next step to see that those who want to use them are given the opportunity to learn how to use them well.

Mr. Pollock. Mr. Chairman, I thank you very much. I did not mean to take so much time.

Mr. Lennon. Thank you.

The gentleman from Minnesota, Mr. Karth.

Mr. Karth. Mr. Chairman, I hesitate to take any time, because of the lateness of the hour.

Mr. Lennon. Go right ahead, until we get a quorum call.

Mr. KARTH. I would like very much, if I may, to explore a few thoughts and observations, and perhaps questions, with the doctor.

I agree with the gentleman from Florida that I really don't think on the basis of the testimony I have heard thus far, that the National Science Foundation is "directing" in the academic field as much as they ought to be, and probably is putting too much effort in fields where they ought not to be.

I did, Doctor, find it very educational to go over your testimony with you, and agree that the National Science Foundation is like an octopus. It has many interests in the field of oceanology going in many directions at the same time.

I am not sure because of that, that we get the biggest payoff for the dollars invested.

Your interest and expenditures are explained in composite, but they are not broken down, and one of the questions I would like to ask is: How much of the $37½ million that the National Science Foundation will spend in this next fiscal year on oceanography-related matters is going into the specialized research facilities area; how much is going into the building of ships and/or the operation of ships, including the salary of the winch operator for example; and how much is going into physical oceanography or biological oceanography, and any of the other areas of interest that you mentioned in your paper?

I agree thoroughly with the gentleman from Florida that your primary, if not your exclusive, interest ought to be in the educational area, supporting undergraduate work, graduate work, research at the universities, summer courses and teacher training programs, and so on, but I am not so sure that you are not spending an inordinate amount of your budget in what amounts to applied research and development.

So if you could furnish those amounts of money that you are going to spend in each one of these specified areas for the record, even though it may be difficult to do so, I think we would find it very helpful, Doctor.

Dr. ROBERTSON. I could summarize it now from some figures that I have, and supply more detail for the record.

Mr. KARTH. I would like it in complete detail.

Dr. ROBERTSON. All right; in complete detail for the record.

I would like to point out that only in the sea-grant program do we have authority to support applied research. The rest of our funds are still limited to the support of basic scientific research, and to the support of education in the sciences.

Now, the funds that we have planned in fiscal 1968 include about $19 million for basic research project support. This can be broken down into biological oceanography, $9 million——

Mr. KARTH. Doctor, if I may interrupt you, I would like to also have you break down the specific research projects, because there is a good deal of difference in opinion as to what is basic, and what is applied, and for that matter, what even might be development.

If you could do that for me, I think we would get a perfectly clear picture of just where the money goes.

Dr. ROBERTSON. I will just summarize very briefly, then, and provide the detail for the record. Nineteen million dollars goes to basic research project support, and we have to be quite careful that it is basic, because if it is applied it is not legal, under our act, except the sea-grant provisions.

For oceanographic research facilities, we have $5 million estimated.

For our national research programs, including the Antarctic program and the ocean sediment coring program, $7.5 million.

For the national sea-grant program, $4 million. For direct science education activities, about $1.4 million, and for other activities, including institutional support and science information, about $1 million.

That is the broad breakdown by categories.

Mr. KARTH. I would assume, however, that a good deal of that $7½ million for sedimentary core research is also tied up into physical things such as ships, and that type of thing, which may well be done by another agency of the Government equipped to do it. This I do not consider to be basic research as the implication may lead us to believe.

I understand that ocean currents are important, and I understand that the topography of ocean basins and all of these things are important, but I have a feeling that perhaps the Navy studied these for some 50 or 100 years, and I am not suggesting that they have done enough in it. I assume that never will the time come when enough has been done. But I do feel strongly that there is more duplication of effort, perhaps, than meets the eye, and that until such time as we have a very careful and explicit breakdown, the committee will not be able to determine whether or not this is true.

I have just one other comment, Mr. Chairman, if I may.

Mr. LENNON. Go ahead.

Mr. KARTH. My colleague from New York mentioned the space program. I would merely like to say for the record that at great expense to the taxpaying public, technologies have been developed by NASA which, in my opinion and the opinion of the people who are much more expert than I am, are very similar to the type of technologies we will be using in oceanology.

In many instances, I am not so sure that this experience has been used at all, and I can understand the reasons why. I know that one agency very rarely, if ever, wants to give up to another agency a portion of its budget, but in addition to that, we have spent many billions of dollars developing good professional teams in the field of research and development, and I think that perhaps they, too, occasionally ought to be called upon.

I have a feeling that maybe this is not the case.

One of the projects that NSF got involved in, which—I don't know—ran into $200-million-plus a year, until Congress felt that it was just tipping over by its own sheer weight, was Project Mohole, as you recall.

There were many of us who felt that from an applied scientific standpoint, from a development standpoint, other agencies of the Government were much better equipped to do this kind of work than was the National Science Foundation, and that, as a result, it grew topsy-turvy, and was not the best utilization of dollars.

If you could break these things down specifically for the record, I think it would be helpful.

Thank you, Mr. Chairman.

(The information follows:)

DISTRIBUTION OF NSF FUNDS FOR MARINE SCIENCES, FISCAL YEAR 1968, ESTIMATED DISTRIBUTION BY SUBDISCIPLINE OR SUBPROJECT

Research in biological oceanography	$7,000,000
1. Cellular biology, dealing with studies of the structure of cells and tissues of marine organisms, including work in embryology, growth, and genetics	764,000
2. Environmental, concerned with whole organisms, and the population and communities of which they are a part. This includes research in ecology of marine systems and limnology	3,080,000
3. Systematic biology of marine organisms, also concerned with whole organisms, particularly their classification and evolutionary relationships. This includes studies in taxonomy, zoogeography, and paleontology	1,686,000
4. Molecular biology, covering biochemical and biophysical studies of the structure and function of molecules and submolecules in marine organisms	190,000
5. Physiological processes, dealing with the study of organs and organ systems in the areas of physiology and matabolism.	1,000,000
6. Psychobiology, concerned with the behavior and mental activity of marine animals	280,000
Research in physical oceanography	4,900,000
1. Physical oceanography, concerned with physical nature of ocean waters and factors that modify them, motion of all scales, from major current systems to local turbulence and surface waves, air-sea interactions	1,800,000
2. Chemical oceanography, concerning the chemical state and reactions within the ocean, geochemical processes, distribution of material introduced by natural causes or pollution	900,000
3. Geological oceanography, concerned with understanding the history of ocean basins, sediment deposition, modification, and movement	1,400,000
4. Marine geophysics, concerned with the major physical processes that have shaped and are shaping the ocean basins, including magnetics, gravity, seismics, and terrestrial heat flow	600,000
5. Data center, contribution to interagency funding of National Oceanographic Data Center	200,000
Ship operations	7,300,000

	Number of ships	Estimated support
University of Alaska	1	$99,000
University of California	7	1,873,000
Columbia University	2	605,000
Duke University	1	603,000
University of Hawaii	4	352,000
University of Miami	2	582,000
University of Michigan	2	76,000
University of Rhode Island	1	251,000
University of Southern California	2	256,000
Stanford University	1	603,000
Texas A & M	1	204,000
University of Washington	3	395,000
Woods Hole Oceanographic Institution	4	1,139,000
University of Georgia	1	31,000
Mote Marine Laboratory	1	31,000
Johns Hopkins University	1	200,000

Specialized research facilities	$4,800,000
1. Construction of laboratory building at Marine Biological Laboratory, Massachusetts	1,900,000
2. Rehabilitation of Oceanographic research vessel Vema for Columbia University	396,000
3. Construction of laboratories and specialized marine facilities and equipment	2,254,000
4. Modernization and improvement of ships operated by several institutions	250,000
National research programs	7,500,000
1. Ocean sediment coring	4,300,000
(a) Lease of drilling vessel at fixed daily rates including cost of crew and vessel operation	2,100,000
(b) Drilling supplies, comprising the costs of expendable and replacement items, such as drill pipe and bits	400,000
(c) Scientific and administrative costs, including core analysis, storage, and other scientific activities undertaken by the university together with the costs of project administration	1,800,000
2. U.S. Antarctic research program	3,200,000
(a) Research project support in chemical and physical oceanography concerned with the physical nature of the Antarctic waters	125,000
(b) Research project support in geological and geophysical oceanography concerned with magnetics, gravity, seismics, terrestrial heat flow, and the history of the Antarctic ocean basins, including sediment deposit modification and movement	300,000
(c) Research project support of the biological sciences concerned with the study of the biota of the Antarctic continental shelf and the surrounding oceans	675,000
(d) Operations support for the USNS Eltanin operated by MSTS and the research vessel Hero to be operated by contract	1,900,000
(e) Facilities: final increment of construction costs for the Antarctic research vessel Hero	200,000

National sea grant program	$4,000,000
1. Institutional support, to conduct comprehensive marine resources programs which include research, education and training, and advisory services	2,200,000
2. Project support—	
(a) in the natural or social sciences relating to marine research and development	800,000
(b) to initiate or expand programs in the education and training of marine scientists, engineers, and technicians	850,000
3. Advisory services covering projects to improve transmission of research results and other information regarding marine resources from institutions and laboratories to the user	150,000
Institutional support for science	500,000
Will provide matching funds for the construction of oceanographic research and training laboratories at an estimated four universities.	
Science education support	1,400,000
1. Graduate education development programs	200,000
2. Traineeships and fellowships programs	200,000
3. College teacher programs	220,000
4. Undergraduate education development programs	60,000
5. Undergraduate student programs	20,000
6. Secondary schoolteacher programs	380,000
7. Precollege education development programs	300,000
8. Secondary school student programs	20,000
Science information activities	500,000
1. Support of abstracting, indexing, and special bibliographies for oceanographers	250,000
2. Support for the publication of monographs, journals, date exchange, and similar services	250,000
International science activities	100,000
Will provide support to U.S. scientists working with Japanese scientists in cooperative oceanographic research projects.	

Mr. LENNON. Counsel?

Mr. DREWRY. Just one question, Mr. Chairman.

On page 8, Dr. Robertson, you mention research vessel *Alpha Helix* as being the only ship in the world designed specifically to meet the needs for marine physiological research. Would you elaborate a little on that, as to just what area the work of that vessel covers?

Dr. ROBERTSON. I would like to call on my colleague, Dr. Carlson, to talk about that, if he would.

Dr. CARLSON. Mr. Drewry, I am glad you asked that question. Thank you very much.

The *Alpha Helix* to me is a floating physiological laboratory, and as Dr. Robertson pointed out in his text, they have worked in the Great Barrier Reef and also in the Amazon and at the present time are working in the Galapagas.

What the University of California has done here is to take a floating laboratory and move it to the remote and relatively inaccessible environments where the individuals, both outstanding scientists and graduate students from the United States and other countries, can carry out a specific program of studies related to the physiological problems of the organisms in the area.

This coming year, they plan to work in the Arctic areas. On or about February 1, they will sail for Dutch Harbor in the Aleutians and there will be joined by the *Northwind*, the Coast Guard cutter.

The *Alpha Helix* is air conditioned, so that it can work in the tropics, and also has been especially reinforced for ice resistance, so that she can work in polar areas.

They will move from Dutch Harbor to Nunivac Island and start following the icepack, studying the physiological effects of supercooling in animals and plan to complete their research program by September 1 at Juneau.

The scientist in addition will place small modular or laboratories on the icebreaker, so that they can extend their studies, allowing additional scientists to participate in the program.

Does this answer your question, Mr. Drewry?

Mr. Drewry. By "physiological" you mean the effect of the environment on the individual?

Dr. Carlson. Yes.

For instance, they will study such animals as the walrus and seal pups and most likely take some of these on board in their laboratories to undertake specific physiological measurements. After they have finished, the animals will be returned to the sea.

Mr. Drewry. Does this involve any physiological studies in regard to the reaction of people to the different places?

Dr. Carlson. I don't believe so, other than measurements that they might make on each other, Mr. Drewry.

I cannot really truthfully answer that.

Mr. Drewry. Standing alone, the only time the word was used in the statement was this once, and I felt it needed explanation.

Dr. Carlson. Well, it is at least as far as we know one of the unique vessels in the world. All the others are large vessels like the *Atlantis II*, the big *Agor* types, or the Russian-type vessels, which are used primarily for physical and biological oceanography.

Dr. Robertson. It will be primarily marine animals and plants that will be studied from the physiological point of view.

Mr. Drewry. Yes.

I have just one other question, Mr. Chairman.

On page 11, Dr. Robertson, you mentioned your investigation as to "the cost-effectiveness of constructing flat-decked ships of the 170-foot offshore supply boat type."

I have heard something about this. In the process of making your investigation of the cost-effectiveness, and I suppose feasibility, have you been working with the Coast Guard in order to perhaps head off some of the problems that might arise out of a question such as the safety aspects of putting your mobile van or mobile laboratory on board?

With the familiarity we have with the Coast Guard, I can anticipate all kinds of questions that might arise, and will arise later, if they are not raised right now, such as the safety of the passengers, and the matters about whether the oceanographic winches are to be treated the same way as cargo winches on a merchant ship.

Have you been working with the Coast Guard in this connection at all?

Dr. Robertson. I don't think that we have had any formal discussions with the Coast Guard. I think that is an excellent suggestion, and we certainly will talk to them before getting much further in this study.

Mr. Drewry. You say you are investigating the cost effectiveness. Do you mean the Foundation, or is there someone who has a grant who is working on this from a ship design and development standpoint?

Dr. Robertson. We have not yet made a design study contract. We have been doing the work preliminary to that, discussing the idea with people in the institutions, and with our own staff, and people from other agencies.

Mr. Drewry. That is all I have, Mr. Chairman.

Mr. Lennon. Doctor, you called attention to something that I recalled when the National Science Foundation sent in its budget request to Congress back in January 1959.

You make it crystal clear that it is the judgment of you and your associates that the NSF has moved steadily ahead, and in its budget request for funding in fiscal 1960 you had virtually $8 million in support of ocean sciences, and now in fiscal 1968, you anticipate somewhere in excess of $37 million.

You say that is progress, at least to accelerate to that extent. I suppose that is about the average.

My recollection is that it is considerably better than the average, because I think nondefense spending is up 61 percent for fiscal 1968 over what it was in either the 1960 or 1961 budget. You have more than quadrupled, a little better than the average nondefense spending.

Now, on page 12, Doctor, you mention the research vessel—and how do you pronounce that name?

Dr. Robertson. *Eltanin.*

Mr. Lennon. Are the scientists from other nations participating in this?

Dr. Robertson. I believe so.

I would like to ask Dr. Jones, who is directly responsible for this program, to comment.

Mr. Lennon. Thank you, Doctor.

Just for the record, we would like to know if this program for this particular vessel, and the surveys in this particular area, envision that scientists from other friendly nations will be aboard to conduct studies.

Dr. Jones. Yes.

This is probably the only major ship working in what is probably the largest "ocean" of the earth. The entire Antarctic Ocean area is as big as the central Pacific, you know.

We have had aboard this ship, and will continue to have aboard, exchange scientists from many nation. I think now the total is something like 15 different nations that have had their scientists aboard this ship, working with our scientific groups.

Mr. Lennon. I wonder if you would be kind enough to insert in the record following your comments, Doctor, a little more definitive explanation of the nations that are involved.

Dr. Jones. Yes.

These nations are the Antarctic Treaty countries. Most of the scientists aboard are arranged by exchanges, not necessarily with other oceanographic ships, because many of the other countries do not have oceanographic ships.

I think one of the unique features is that on this ship we have had the first real exchange with the Russians by which we have had a Russian scientist on our ship, and we have one of our men on one of their oceanographic ships in the same area, all of these men had worked together.

Mr. LENNON. If you would do that for us I think it might be helpful, because somewhere in the news media this has been referred to. Sometimes we get questions about it.

Dr. JONES. I should be glad to, and if I could add also the new research trawler, the *Hero*.

(The information follows:)

Foreign scientists and technicians on USNS Eltarin, cruises 3–31, 1962–67

Antarctic treaty countries:	
Argentina	10
Australia	4
Belgium	1
Chile	27
France	2
New Zealand	10
U.S.S.R.	1
United Kingdom	3
Total	58
Other countries:	
Brazil	2
Canada	2
Republic of China	1
Federal Republic of Germany	2
Iran	1
Israel	2
Spain	1
Total	11

Mr. LENNON. What?

Dr. JONES. The new wooden research vessel, the *Hero*, will probably be the last of its type built. It is 125 feet long, with the hull 22 inches thick, solid oak. It is being named the *Hero* after Nathaniel Palmer's ship, the man who discovered the Antarctic. The *Hero* was the ship in which he went down there.

It will be doing very valuable work in an almost untouched area, one of the richest in biological material.

Mr. LENNON. Dr. Robertson, you list the status of NSF support of the major research vessels, and the state in which it makes the predominant contribution to the operational support, as I understood your testimony.

Dr. ROBERTSON. We share the support in most cases.

Mr. LENNON. I understand it is substantial.

Dr. ROBERTSON. NSF provides substantial support, with ONR putting in more in some cases than we do.

Mr. LENNON. Attachment 3 is what has taken place in the past. There is nothing in your budget for fiscal 1968, is there, for new construction, or conversion of major oceanographic research vessels?

Dr. ROBERTSON. We have nothing in this year's budget for ship construction.

Mr. LENNON. When you say "this year," you mean what?

Dr. ROBERTSON. The year in which we are currently working, fiscal 1968.

Mr. LENNON. So what you are referring to in attachment 3 is in reference to these vessels in which you have been involved, in either new construction or conversion?

Dr. ROBERTSON. That is correct. These are ones which we have funded.

Mr. LENNON. I just wanted that corrected for the record, because I knew that some of these vessels had been in operation for some time.

Gentlemen, we are going to conclude the hearings this morning, and want to express to you, Dr. Robertson, and your distinguished associates, our appreciation for your cooperation.

We had hoped, of course, to finish your testimony and the interrogation by 11 o'clock, and start with these other distinguished gentlemen, but that just means we don't see enough of each other, because we have so many questions. I have more that I would like to ask, but we will not take the time.

That will adjourn the meeting today.

(Whereupon, at 12:20 p.m., the subcommittee adjourned, to reconvene at 10 a.m., Friday, December 8, 1967.)

NATIONAL MARINE SCIENCES PROGRAM

FRIDAY, DECEMBER 8, 1967

House of Representatives,
Subcommittee on Oceanography of the
Committee on Merchant Marine and Fisheries,
Washington, D.C.

The subcommittee met at 10:10 a.m., pursuant to call, in room 1334 Longworth House Office Building, Hon. Alton Lennon (chairman of the subcommittee) presiding.

Mr. Lennon. Gentlemen, the subcommittee will come to order.

We welcome this morning the distinguished Assistant Administrator for the War on Hunger of the Agency for International Development, the Honorable Herbert J. Waters, who will be accompanied, I understand, by George Parman, Director of the Food from the Sea Service. Is he here this morning?

Mr. Waters. He is here, Mr. Chairman.

Mr. Lennon. If you want him to sit there with you, we will be delighted to have him come up at this time. There may be some questions subsequently directed to him, and he will not have to move.

Sir, you have a prepared statement, I believe, and I assume that you will follow the contents of this statement. It is likely there will be some interrogation with respect to your comments.

You may proceed, if you please, sir.

STATEMENT OF HON. HERBERT J. WATERS, ASSISTANT ADMINISTRATOR FOR WAR ON HUNGER, AGENCY FOR INTERNATIONAL DEVELOPMENT, ACCOMPANIED BY GEORGE PARMAN, DIRECTOR, FOOD FROM THE SEA SERVICE, AID

Mr. Waters. Thank you.

Mr. Chairman and members of the committee, I deeply appreciate the opportunity to appear before the Subcommittee on Oceanography of the House Merchant Marine and Fisheries Committee. We in the Agency for International Development consider ourselves fortunate to have a part in the important and exciting work which was initiated under the Marine Resources and Engineering Development Act of 1966. As you may know, Mr. William S. Gaud, Administrator of the Agency for International Development, sits in on the deliberations of the National Council on Marine Resources and Engineering Development which meets under the chairmanship of the Vice President, and as your committee also knows, my Agency has been assigned the important task as the lead agency in helping to develop fish protein concentrate as a new source of protein energy for the large and unfortunately growing number of malnourished people among the world's population.

In response to the demands of the act and of the Council, the Agency for International Development has created a Food From the Sea Service within the Office of the War on Hunger. I believe it is a fortunate conjunction of circumstances under which the increasing realization that an unfavorable balance exists between the world's population and the amount of food produced came at a time when it was also realized that the ocean contains a vast reservoir of untapped food resources. While food from the sea is not a panacea, it will be an indispensable weapon from the world's war on hunger.

Marine resource development has always had a part in our AID programs. An example of the kind of important work undertaken in the development of fisheries is found in Korea, whose offshore resources have enormous potential. Considerable technical assistance in which the Bureau of Commercial Fisheries participates under AID funding has been provided to Korea in the fisheries field for a number of years. Surveys have been made on salmon, oysters, and trout production possibilities, and the current year's program includes $102,000 in grant funds for further market feasibility studies and technical assistance.

More important, the Korean Reconstruction Bank, with loan funds provided by AID, will lend some $3 million this year to Korean fishing cooperatives for the purchase of modern equipment, including refrigerator ships, deep sea trawlers, and so forth.

Nor has research and exploration been ignored. In Vietnam AID, in cooperation with the U.N. development program and the FAO, the Food and Agriculture Organization of the United Nations, is helping to explore unused offshore potentials off the mouth of the Mekong River. The Vietnam fishing program also includes training of Vietnamese in modern fishing technology, production and distribution of fingerlings; construction of fish ponds; distribution of fishing boats and gear on credit; construction of fish-landing facilities, and ice plants and processing. A funding level of $320,000 is proposed for fiscal year 1968 to continue the development of fisheries in Vietnam.

The Agency intends to continue and, if possible, intensify this type of assistance in the development of marine resources. There will, however, be one important difference. While in the past fisheries resources have been looked upon as an important possible source of a country's export earnings, with consequent concentration on the higher priced types of fish, our emphasis in the future will be on the low-cost mass production of fishery products for widespread consumption in the developing nations themselves.

Specifically, we aim to establish the technological and economic capacity for less developed countries to utilize their marine environments in a manner best designed to eliminate their own nutritional deficits. This goal will be sought by—

(*a*) Assisting less developed nations to identify and expand the dimensions of their local fishing industries,

(*b*) Establishing the feasibility of commercial operations in the application of available marine science technologies, (*c*) Fostering the investment of private enterprise in the establishment of permanent oceanic food production, distribution, and marketing institutions,

(*d*) Insuring that the technologies thus applied are constantly improved, and that technological deficiencies which may appear are eliminated, and

(*e*) Assisting less developed nations to establish and develop institutional competence in the relevant marine and food sciences.

Spearheading this drive to exploit fish resources as a major low-cost item of high protein nourishment for large masses of people is the Agency's work, backstopped by the Bureau of Commercial Fisheries, in the developmnet of fish protein concentrate as a source of health and energy in the battle against undernourishment.

AID is tackling this task on two fronts: Through assistance to less developed countries in exploring possibilities for indigenous FPC production, and through the use of domestically produced FPC in our worldwide food aid programs.

Our initial efforts are focused on the production and distribution of FPC in five principal areas:

(*a*) Assisting in the development of a commercial process for producing FPC.

(*b*) The improvement of fish-catching, landing, and processing capabilities in at least three protein-deficient countries.

(*c*) The development of FPC markets in at least one protein-deficient country.

(*d*) The establishment of a viable commercial FPC system in at least one protein-deficient country.

(*e*) The encouragement of other nations and private interests to establish commercial fishing industries wherever feasible.

To achieve these goals, AID is employing a systems approach designed, first, to identify opportunities for maximum impact and, second, to provide the means required to attain maximum impact. These considerations are embodied in the FPC demonstration program and entail:

(*a*) Selection of three countries for FPC demonstration projects. An AID–BCF team recently completed surveys of eight nations in Latin America and Asia, and another team will conduct a survey of several countries in Africa within the next 90 days. The demonstration countries for Latin America and Asia are in the process of being selected.

(*b*) Conduct of feasibility studies in each of the three demonstration countries to determine whether and in what manner FPC-fortified foods can be marketed commercially. These studies will employ all of the modern marketing techniques presently available, and will be carried out under contract with private industry.

(*c*) Establishment of FPC industries in at least one of the demonstration countries. Properly executed, the feasibility studies mentioned above should furnish the data and incentives necessary for large-scale investment in FPC industries by the private sector.

Of substantial interest, I believe, is a proposal on which we are currently working, to combine our own marine resources with our advanced technology and our abundant agricultural production to provide a new source of protein energy to millions of persons, principally children, pregnant women, and nursing mothers, under AID's worldwide food assistance programs. These programs are undertaken in cooperation with the U.S. Department of Agriculture under the Food for Peace Act of 1966, Public Law 480.

The proposal on which we are working actively is to use domestically produced FPC to enrich wheat or a combination of grains provided by the Commodity Credit Corporation for distribution as specially formulated foods in AID's worldwide food donation programs.

Our various initiatives in the development of AID's food from the sea program have elicited widespread interest in cooperating countries, other U.S. Government agencies and in U.S. industry. The latter has shown a great deal of interest in both the production and marketing of domestically produced FPC and in the possibility of construction and operation of FPC plants abroad if AID-sponsored feasibility studies indicate commercial viability.

The foreign assistance authorization, just passed, urges the President and the Agency for International Development to allocate a minimum of $2.5 million to programs of the type outlined above. We believe these funds and the programs I have described will make a substantial contribution, not only to the development of worldwide marine resources, but to the world's war on hunger, which must be won if mankind is to live in reasonable dignity and peace.

Mr. Chairman, I have Mr. Parman with me, who heads the Food from the Sea Service. If it would be helpful to you, I would like him to make a brief comment on some of the technical aspects of the problems we face. We will both be available and happy to discuss further details with you.

Mr. LENNON. We will be delighted if you will do that now, sir.

Mr. PARMAN. Thank you, Mr. Chairman.

Very briefly, we have in the seas an enormous food resource. The main purpose of our program is to bring this resource effectively to bear on human feeding. The seas, which constitute 71 percent of the surface of the earth, are the major areas of photosynthesis which eventually results in food. Currently we are getting 55 million metric tons of edible food products out of the seas every year. It looks as if we can get 200 million tons out with our present knowledge.

The problem which we have in the fish area, however, is that of keeping the fish without expensive refrigerant. It is to meet this problem that has made this fish protein concentrate so attractive, because we have in effect made a powdered concentrate of fish with remarkable storage stability and with excellent nutritive value that can be added to other types of foods to enhance their protein value at normal levels of use without affecting their taste or their texture or the appearance of the food.

We can, for example, add 5 percent to flour and get a flour containing a very high level of very good quality protein and have very little effect on the appearance of the fresh bread.

Mr. POLLOCK. Five percent of FPC powder?

Mr. PARMAN. Five percent of FPC powder in flour. This results in a product with up to 15 percent protein, and excellent protein at that.

I do not know how much we need to go back in history on this, except that many of you, I am sure, will remember the involvement we got into in the problem of trying to get FDA approval for FPC made from whole fish. That was solved by the Bureau of Commercial Fisheries embarking on a program, on the advice of the National Academy of Sciences, to produce a product that was wholesome and nutritious. I had the pleasure of serving on the committee that advised the Bureau in that development. In February of this year we got the Food and Drug Administration approval for the Bureau of Commercial Fisheries process which utilizes fish extracted with isopropyl, and at the same time the Viobin Corp. got approval for a process using dichlorethylene. Both processes use hake as raw material. The hake was selected initially because it is in large supply, a lean fish not too well utilized in the world fish markets, and there is lots of it around the world. We are continuing the experiments. There is lots more to know. We are continuing experiments with high-fat fish like menhaden, sardines and herring, which are also likely to be raw material resources particularly in the tropical areas.

These and matters of solvent recovery, mixed batches of fish, and so forth, become important further research projects that must be continued in this area, but we do at the present time have two approved processes, and it is on these we are building our program.

There is a third process coming down the line, a process developed by a Swedish firm called Astra, very similar to that developed by the Bureau of Commercial Fisheries, which is receiving some publicity in Europe. They are planning to set up an American firm, I believe, to exploit it in this country.

The processes are all very well. My background is in food marketing and the food industry. I have learned the hard way, both in this country and abroad, that the process is not important. The important question is how to sell the product.

It is useless to put plants up until you know what you are going to do with the product. So, the emphasis in our program is marketing: to answer the question, "How do we sell it, and how much can we sell?" from which you can make legitimate business decisions as to whether or not you can afford to invest in plants.

The program is based on the philosophy there is no point in anything unless it can stand on its own two feet and have permanence. I do not hold that heavy subsidies going in forever and ever are permanent. I think the product must be wanted by the consumer if the consumer continues to support it.

We are approaching the market, therefore, in three phases overseas. Again, we think this is innovative and valuable. The first phase is a systems analysis of the market. "Systems analysis" is a fancy way of saying a study of all facets of the market, to get measurements, to determine when approaches should be made and what these mean in terms of overall market penetration.

For the second phase we plan to make a study of the characteristics of the market insofar as the cultural and social attitudes toward food and nutrition are concerned. This is based upon the strong belief that we are expert marketers in this country because we know our own society well. We know the arguments to use to convince people of various economics strata in our society that they should buy a new car or should try a new cereal or a new drink or new whisky. We do not have the same insights into other societies. We hope to get insights which can be used then in conducting the third phase, which is the standard marketing test to find out what foods you will put it into, and take it out, and make your appeal to the people and see if you have a viable market and how you can approach that market.

This, very briefly, is what we hope to do, and it will take us a year or so to do it. Again, the goal in this will be to determine if there is a market and, if so, how do you reach it and how big is it, from which we make our final decision about plans.

I can say from our conversations with industry, if we come up with good figures on the market, I have no doubt in my mind that American industry will rise to the challenge and will make the investment with the minimum problems on our side about funding.

I will be glad to answer any questions you have. Thank you very much.

Mr. LENNON. Thank you very much.

(Off the record.)

Mr. PELLY. I have a number of questions, Mr. Chairman. Perhaps Mr. Waters probably would be the one I should direct them to first.

Although I am very sympathetic with the effort to wage war on hunger, I also am mindful of the fact that 15 years ago the American fishing industry used to produce 60 percent of the fish consumed in this country. Gradually, however, because of foreign aid and other processes, foreign countries now are taking over our market. We now produce less than 20 percent. I therefore am concerned about the possibility that, while we may be helping malnourished peoples in foreign countries, we also may be making our own fishing industry hungry. Would you care to comment?

Mr. WATERS. I would be happy to comment on that, Congressman. I think you have raised a valid point of concern. I think there are both short-run and long-run answers to it.

In the long run, the greatest hope of the fishing industry in this country or the agricultural industry in this country is really to raise the living standards of the world and to raise the total consumption of food worldwide. At the rate the population of the world is growing, I think we will have need for all the food of all types we can make available over the next 25 years.

That does not, however, answer the immediate problem of the man faced with earning his income this year and having to compete with outside sources. This is why I mentioned in my statement that we have redirected the focus of our attention not only in the fish aspects of our program but in our foreign aid program generally, toward the encouragement of meeting their own food problems within the developing countries. We are doing the same thing in agriculture that we are doing with the fish products.

Mr. PELLY. For example, you have been trying to help Korea. The first thing we know, Korea is using this technical know-how that we are giving them to export fishing products. We find Korea coming back into our own market almost to the point of dumping, and destroying the livelihood of our own American fishermen.

I am not picking on Korea. I could name other nations. However, I hope you are changing your focus so as to assure that you are aiding the domestic food problem of such nations and not their export capabilities.

Mr. WATERS. This change in our total policy started at the first of the year and has redirected to a considerable extent this year's program, and will be more so in next year's program. All of our guidelines and instructions are in the direction of the encouragement of products that can be handled internally for wider distribution where, as in the back country of Korea, for example, they lack the refrigeration facilities for fresh fish products. The development of new forms of products and new types of food that can be widely accepted in their country will make for a greater use of their own fish catch rather than for export earnings alone. We are changing the direction to try to encourage the raising of the quality of the food as well as the quantity of food available within the recipient countries.

I must say there has been an awakening in most of the developing countries that they themselves have to come to grips with this problem. They all started out to be big export earners.

Mr. PELLY. Russia today is perhaps the largest fishing country in the world. I do not know how much fish protein concentrate it exports but it must be substantial.

As far as I can see, you are not directing your program with regard to protecting American interests as conservation goes. You provide, for example, freezer equipment, fishing vessels, and technical know-how, all of which seem to be employed so as to work against our own conservation efforts.

I mentioned the Koreans. They now want to come over and fish in resources which in the past we have looked to ourselves. Yet, we have to conserve those same resources because they are being destroyed by overfishing.

Mr. POLLOCK. Would the gentleman yield? This is a point of great concern to us. Not only has South Korea gone from seventh place to fifth in the last 10 years in world fishery production, they are now about to go past us. Not only are they coming into our waters and taking our fish, which affects our fishermen, but they are selling in our markets here, not using it at all for food consumption in the countries we are trying to help.

I would like to know, if I could—I am sure Mr. Pelly would—how specifically you are directing them. What is it you are doing to direct them to utilize our taxpayers' money to finance ships that feed their people out of resources of their own?

Mr. PELLY. You have stated that $3 million will be loaned this year to Korean fishing cooperatives for the purchase of modern equipment, including refrigerator ships and deep sea trawlers. I would like to know how much of that equipment will be employed in competition with the American fisherman and in taking our fishery resources.

Mr. WATERS. I think I can assure you that in the Korea negotiations, the emphasis is entirely now on upgrading their consumption of fish products within their own country. The leverage we have is not just our aid to fishing activities; we use our total AID program discussions with Korea, on reorienting what they are doing for their own people. This is part of the turnaround of our entire foreign aid program.

I suppose agriculture is the best example I can cite. We have not had much experience with the turnaround on the fishing side, but we have on the agricultural side. I know that is of great interest to your State, too, Congressman Pelly. On the agricultural side we have had the same concern, a very valid concern over a number of years whether we were stimulating agricultural production in other countries coming into competition with our own. We still have that concern. However, the experience over the years has shown that the countries that we have been able to get on their own feet and raise their living standards and get off the AID roll became our biggest agricultural customers, became dollar customers. That was true of Japan.

Mr. PELLY. Are they buying our fish?

Mr. WATERS. In the total trade pattern with the United States, they have been buying more of our farm products as they increase their farm production.

Mr. PELLY. What we want them to do is to feed their own hungry people with the fish they catch. We do not wish to see our own fishery resources destroyed in the process, or witness further encroachment upon our own markets.

We also are getting inferior products, such as Greenland halibut, which is not a halibut but a flounder shipped into our country. The housewife does not know the difference. She only sees that it sells for a cheaper price. Yet we cannot get the cooperation of the Federal Trade Commission to require adequate labeling. Proper labeling of such fish products would be of some help.

Mr. WATERS. Of course, labeling is a problem beyond our control. We can be influential and helpful in broadening the acceptability in the markets within their own country. We feel that there is a greater opportunity to do this in the development of new food products rather than just the conventional food products, fish as fish. If we are to broaden the use of fish in formulated products such as we are going to experiment with, with new fish protein concentrate, it will tax the capacity of their industry to handle this type of approach in our studies prove productive.

(The following was supplied in reference to the above:)

KOREAN FISHING PROGRAM

The total catch of fish in Korea for CY 1966 was 420,000 MTs of which an estimated 386,000 MTs was consumed locally. All indications are that the consumption of fish by the Korean population will increase to over 500,000 MTs by 1970. This is in keeping with population increases, per capita income growth, and most importantly, with present hopes of the National Health Services to increase the present individual daily intake of protein from 70 to 80 grams a day during the next several years.

It is difficult to make an estimate of the amount of fish in the average Korean diet since it varies greatly from coastal to inland areas, as well as between urban and rural populations. However, using existing statistics in Japan as a guide and making allowances for differences in the availability and marketing of fish as opposed to other sources of protein, we estimate that roughly 12 percent of the daily intake of 70 grams of protein is derived from fish in the Korean diet. Considering the scarcity of other sources of protein, there is a coordinated effort now to increase the consumption of fish in Korea by improving the catch and particularly by bettering the methods of preservation and marketing of fish in the interior of the country.

U.S. assistance to Korean fisheries is designed to assure an increase in the annual catch proportionate to the anticipated annual increases in consumption. Concurrently AID and the ROKG have, or are in the process of obligating from the U.S. program, $3 million in DL funds for the construction of fishing vessels primarily for coastal fishing (two long-liners of approximately 300 tons displacement; five live bait boats and some 350 tons displacement; ten 70 ton shrimp trawlers, and two refrigerated vessels of from 800 to 1,000 tons each); $200.000 in DL funds to finance a study to improve the local fishing industry; and approximately $50,000 in DG funds to finance the salaries of two U.S. fishing advisors.

Mr. PELLY. It is hard for me to reconcile on the one hand your statement that we are trying to assist these countries in developing commercial processes and, on the other, a long song and dance about how we ourselves are trying to develop a process so we can sell to the foreign countries. Certainly we want to export goods. We need the dollars. However, it does not seem to me that the two programs harmonize with each other. Poor countries certainly must learn to catch their fish, process it, and market it, but in so doing will not our own overseas market be diminished?

Mr. WATERS. That is right. We are moving on both fronts. We have learned from the food distribution programs under Public Law 480 that in the long run our goal must be to eliminate the causes of dependence on food aid. We must get them to plan their production patterns to be able to meet their own requirements or earn enough to buy the additional amounts from the world market rather than under the aid programs.

Mr. PELLY. The Bureau of Commercial Fisheries is under the jurisdiction of this committee, and the Subcommittee on Fisheries and Wildlife has heard considerable about fish protein concentrate. We are very much interested in it and think it has great possibilities.

Your statement on this subject sounds as if maybe we are duplicating work in this field. I hope that is not the case.

Mr. WATERS. No, not at all, Congressman. We work hand-in-hand with the Bureau of Commercial Fisheries. In fact, under the assignment of the Marine Resources Council as being the coordinating agency, I have been designated Chairman of the Food From the Sea Interagency Committee, which includes the group of agencies that are involved and have a sharing of interest.

Actually, our Agency does not try to maintain a large staff itself or to do much of the technical work itself. We do these activities under participating agency service agreements where we provide the funding for work by the Bureau of Commercial Fisheries. In fact, we pay for their assistance in our overseas work as well as last year we transferred $200,000 to the Bureau of Commercial Fisheries to help with their pilot plant on fish protein concentrate.

Mr. PELLY. Do you know if they have selected a site for the research plant?

Mr. WATERS. I understand that is ready to go very shortly.

Mr. PARMAN. I have not heard.

Mr. PELLY. I understand the plant is to be constructed pursuant to legislation passed upon by this committee and enacted which seeks to develop a low-cost, wholesome fish protein powder which your Agency, among others, might use. Are you working on this?

Mr. WATERS. No. We are the users. We are anxious to have them move ahead as fast as possible, or even faster. In fact, in our decision to go ahead now with the planning for use of domestically produced fish protein concentrate, some have felt we were putting the cart before the horse, because right now we do not have the volume available that we are willing to use.

We felt committing a portion of our funds to buying fish protein concentrate to blend with food available from the Commodity Credit Corporation under Public Law 480 would give assurance to the private industry to move ahead on larger scale planning of their own activities and to expedite the production. Private industry would not be able to move ahead very rapidly until they see an immediate market.

We hope the market eventually will be a commercial market in this country, but as an assurance to get started, we are earmarking out of this fiscal year some $1 million to buy a fish protein concentrate in this country to blend in with formulated foods that we are going to distribute, which will in effect be a worldwide sampling device to help introduce this new product and get it its acceptability through school feeding programs and child welfare programs. Whether or not we will have the availability of the fish protein concentrate by the end of the fiscal year is one of the questions we have to face.

Mr. PELLY. You do not know whether you have the money to finance those programs.

Mr. WATERS. Even with our somewhat restricted funds this year, we feel this is something we ought to make a start on.

Mr. PELLY. I agree with you. I think this is a wonderful way in which to help hungry humanity.

However, I do not think we should develop foreign industries or co-ops, or whatever they are, in such a way that they then can come over and deplete the limited stocks of fish we have off our coasts.

The Russians and Japanese now are fishing off our coasts. We do not want any more over here. As it is, we have to work out arrangements and agreements with these countries to share fishery resources and we are getting down to the bottom of the barrel in some of the areas.

Thank you, Mr. Chairman.

Mr. LENNON. Mr. Pollock.

Mr. POLLOCK. Thank you, Mr. Chairman.

Mr. Waters, I am obviously concerned, as the gentleman from Washington is, about this. It seems to me the real danger is that we will end up financing these so-called food-deficient countries to develop fishing techniques to compete with our own fishermen in our own waters and have them sell in our own market and do it at a lower price. It will create an economic disadvantage to us which is very serious.

I am not sure you answered my question before. How can you control this? If you finance a new freezer ship for the South Koreans, as an example, are they not going to try to go into the most productive waters in the world they can, and come right over into the waters around Alaska? If they do this, it will be more economically productive for them to sell in our market than to feed the people you are trying to help in the first place.

Unless the funds which you give them, the grants which you make, the money which you finance, is strictly controlled and subject to being cut off if it is utilized wrongly, I do not really see how you can accomplish what we think is a very important control.

Mr. WATERS. I am not sure that I can fully answer you on the control except with the influence we have used on getting Korea to change its internal policies for greater emphasis on improved food distribution and food consumption levels within their own country.

I went over, with their Health Minister and their Education Ministry, their timetable and schedule for phasing out food assistance from the United States which calls for a greatly stepped up use of their own fish resources for their country. They are going to have to do more fishing on their own offshore areas to be able to do this. I do not think it is going to be economically feasible for them to explore the world to bring fish back to Korea.

It is going to be more of their own resources they have to use. The same problem is a general problem in the development of these countries around the world. I think we had the same concern with the Marshall plan days of Europe and other countries, and yet the statistics of trade in the world have shown that trade has expanded as the living standards of these countries have gone up.

Our general share of trade has expanded with it. We do more commercial business with Japan, Taiwan, Israel, and many of the countries graduated out of aid. While they now stand on their own feet and produce more for themselves, they are also buying more from the United States.

Mr. POLLOCK. I do not think there is any question about this, Mr. Waters. I think here we have a little different situation. Here we are trying to develop an entirely new industry, entirely new product—fish protein concentrate.

It would seem to me useful to take our fishing areas in this country and take some of this money to build plants here to develop this industry. This would help the fishermen, our economies, develop the product and make that available to these people instead of having them compete with us on every level in this one regard.

Mr. WATERS. I am not sure that we ever could develop a fully commercial market in the world for fish protein concentrate food products made in the United States and moved around the world. It depends on the end product. The end product is going to have to be tailored to each country. Whatever they now normally eat, we must develop a product built around that containing fish protein concentrate. They are going to want to get it from their lowest cost available source. That is going to be out of their own fishing facilities.

I do not question at all the potential for fish concentrate blended within the United States or within our normal marketing of food products around the world. It is not going to be fish protein concentrate people are going to eat; it is a product made from fish protein concentrate, a supplement. The product has to be really designed to fit the local tastes and local needs.

In the Latin America areas we have more acceptance for corn-based products. For the countries in the Far East, we may need a food product that is a mixture with rice, something of that nature. This is a part of the studies that have to go on to design a product that fits the particular country concerned.

Mr. PELLY. Would the gentleman yield?

Mr. POLLOCK. Yes.

Mr. PELLY. It seems to me we have had situations such as you mentioned. South Korea expressed a desire to fish the Bering Sea. Our country, through a Halibut Commission, has protected and has developed halibut banks there for 40 years. There is not room for another nation. In the biggest area we let the Japanese come in and share it with the Canadians and ourselves.

If we are going to help Korea—and I hope we will—then we certainly should consider reaching some understanding that its fishing industry will stay out of certain areas where owing to depleted resources we have an interest in fostering conservation. It seems to me we would say, "We will give you this aid, and help you to develop processing plants for your own consumption, but in return we insist that you stay away from our historic fishing resources where we have practiced conservation throughout the years."

Mr. WATERS. Congressman, I think the guidance of this committee in its expressions are helpful to us in guiding our planning. I would have to add, however, that I am not sure that the AID agency alone can do this. Some of these questions would probably be better put to Mr. Pollack and others from the State Department on general policy. There are areas of international relationships.

Mr. PELLY. In any program there is a giveaway of some kind. I never saw them yet where they weren't thinking of the other fellow. They are great humanitarians.

Mr. WATERS. We are having to balance between the foreign policy objectives but our main objectives are developmental objectives. We are very conscious of American trade in our activities. We feel we should contribute to that in any way we can and not discourage our own trade. We have a very active balance-of-payments committee and we have tried to weigh our aid activities in the light they will not hurt the American balance of payments but will help them.

Mr. PELLY. If the gentleman will continue to yield to me, I would like to mention the seizure of American fishing vessels by certain Latin American countries. The State Department reimburses our fishermen for fines rather than take appropriate action to prevent harassment of our fishermen, including seizure upon the high seas, and the levy of very heavy confiscatory fines. Still we continue to give foreign aid to these offending nations.

Mr. WATERS. We have had very drastic curtailment and practically suspended our programs as a result of some fishing disputes in some of those areas. I think there is a policy question and it might be more properly directed to the——

Mr. PELLY. We have not been very successful in negotiating with such countries.

Mr. POLLOCK. I gather from what you were saying before, that your program would envision establishing these fish protein concentrate plants in these various countries as distinct from developing American industries to sell the fish protein concentrate flour in these countries as a product there which would help our balance of payments.

Mr. WATERS. We are aiming to do both simultaneously. We don't think the answer is going to be just publicly built plants.

We are going to try to develop the incentive for a private development both in the United States and overseas. By our being willing to invest the money in buying domestic fish protein concentrate for our food programs, we hope to give a lift to the domestic industry. It may well develop faster domestically than we can proceed overseas. We think both sides have to be looked at at the same time.

Mr. POLLOCK. I appreciate what you are saying, but it would appear to me that you could encourage private industry in this country.

Helping small businesses is one of the broad things we are trying to do in this Nation. If you would award contracts to them to furnish fish protein concentrate to certain countries, the end product is not going to make any difference anyway. You are going to have to come up with a flour no matter where you produce it.

Mr. WATERS. The question is getting the initiative and drive of American business to develop the marketing mechanisms overseas. If we are going to develop the fish protein concentrate in this country to turn over to governments overseas or sell to governments overseas, we are only going to perpetuate another donation program.

Our problem is to get a balance between them. We are willing to use the subsidization of food in special programs, particularly for children and mothers, as a way of developing acceptance of it so that there will be an industrial potential. Our hope is to get it on the store shelves rather than on the Nation's donation program.

Mr. POLLOCK. Is your program overseas concerning the fish protein concentrate under the auspices of the Food and Drug Administration? Are you subject to the same restrictions in South Korea in marketing the product as we are here where it has to be 1-pound packages clearly labeled?

Mr. WATERS. The Food and Drug Administration is a regulatory body controlling the sales in the United States.

Mr. POLLOCK. Except that we are using American dollars?

Mr. WATERS. They do not control it overseas, except from this aspect: It is very difficult to introduce commercially and gain acceptance of a product overseas that is not accepted in the United States. In other words, those who want to oppose the introduction of the product can point to the fact that the United States is trying to make us develop a new food that they are not willing to eat themselves.

This is a difficulty in trying to introduce food not acceptable in the United States.

Mr. PARMAN. May I add to that?

Mr. POLLOCK. Yes; sir.

Mr. PARMAN. We plan to abide by the essentials of the fish protein concentrate regulations but not with the requirements for marketing in one-half and 1-pound packages.

Mr. POLLOCK. The essence of their regulation was that we not sell it in bulk and have it lose its identity.

Mr. PARMAN. I could make a comment on that but I shall not. The point which I think I would like to make is that with proper marketing development, there is a market for fish protein concentrate in this country that will far exceed the overseas market.

There is a tremendous marketing potential for fish protein concentrate. I think this should be investigated. This is not our responsibility however.

Mr. POLLOCK. You know, Mr. Chairman, every time I look at the advertisements on television about morning cereals on the market today, which are nothing but straw really, and all the energy derived from them, most of us realize it is just propaganda. This would be an area where fish protein concentrate could really be utilized and give American people something which I think they are not getting now.

Mr. PARMAN. Yes, sir.

Mr. POLLOCK. You talked about two approved processes. Were you talking about mechanical and chemical or something else?

Mr. PARMAN. No, sir. The Viobin Corp. has a process that involves the solvent dichlorethylene. On the fish protein concentrate, the Bureau of Commercial Fisheries process is a solvent extraction using isopropyl alcohol. These are the two FDA-approved processes.

Mr. POLLOCK. Although they are not fully developed, there are three different basic processes by which this extraction can be made?

Mr. PARMAN. You can do it by quite a number of ways, but these are the only two approved so far. The real point is that there are many ways to achieve the same result.

Mr. POLLOCK. On page 4 of your statement, Mr. Waters, you talk about listing your additional efforts being focused on production of fish protein concentrate in five principal areas. I am not sure that I understand what you are saying. Is there any difference between (c), (d) and (e)? You are talking about the development of these markets in one protein-deficient country and in the next breath about the establishment of a viable commercial fish protein concentrate system in at least one of these protein-deficient countries.

Are you not saying the same thing there? In the last part you say encouragement of private interests to establish commercial fishing industries wherever feasible.

Mr. WATERS. I think in (c) I am referring to studying out the market, proving there is a market. We are starting off to make sure we have the process. Then we want to improve the fish-catching abilities and handling abilities to serve that process.

We probably should have said studies of the market rather than development of the market, proving the market is there, and then moving from there to actually establishing a commercial industry even though it may require starting with some support from school feeding activities, some governmental help. We want to try to establish a viable industry. This we are doing on a demonstration basis to reach the goal.

The last point was to indicate we are not going to discourage other efforts; we are going to encourage efforts by others in any other country. We are not going to try to spread ourselves too thin by trying to do it everywhere at once, but will try to encourage other governments and private interests wherever they can to expand their own efforts to go ahead with fish protein concentrate development.

Mr. POLLOCK. Thank you.

Is it possible today for a small fish-processing plant anywhere in the United States, not in this business to get a contract from AID to sell the product on some limited basis, some limited quantity to a foreign country as a basis for backing up collateral of that company alone?

How do we get private industry in this business when there is no market unless you are talking about the big man?

Mr. WATERS. We are not direct buyers of food products in that sense. However, under the plan we are working on, for which we are trying to work out the details now, we would hold up a target of $1 million and say, in effect, "We will provide an assured market if somehow it is produced." We will take $1 million of that production off the market. We are working on specifications for an end product we can use. We will do this through a transfer of funds to the Department of Agriculture, to mingle with their funds that will finance a combination of corn, soya, milk, and fish concentrate. It would make an ideal formulated food to meet all the nutrient needs of mothers and children.

This will probably be produced by millers who are not in the fish protein concentrate industry. They in turn would have to be the buyers from whoever produces the fish concentrate.

The procurement system is what we are working out. We do not think we are going to get any suppliers starting to produce until we hang up a target or amount that we would take off the market in a given year. Rather than just buy the fish concentrate and try to go into producing an end product ourselves, we want to encourage the major food processors, the General Foods people, corn-milling industry, wheat people, any other industry that wants to compete, in finding who could create the best blend of a product with fish concentrate in it, and come up with a food product that we can introduce to the world.

We are going to try to start some competition in this field.

Mr. POLLOCK. Are you visualizing a product such as a powder or flour?

Mr. WATERS. Yes, sir. We visualize a product with the simplest preparation possible. Our experience overseas indicates that a precooked form that can be quickly and easily prepared with just hot water, is easiest to introduce. We have had experimental success around the world in a formulated food we call CSM, which is a corn, soya, and milk mixture. We are convinced from a nutritional and cost standpoint that we can upgrade the quality of the protein in this formula by making a percentage of it in fish protein concentrate, and have an acceptable food because it is already in use.

We have some 400 million pounds of this CSM now being used in donation programs by 80 countries. This is made available to groups such as Catholic Relief Service, CARE, and Church World Service, as well as in intergovernmental programs by using the American voluntary agencies in distributing such products we can watch the results and get reports back on the acceptability. By being a powder product, it can be prepared in many ways, such as a simple mush or gruel, almost into a drink by liquefying. It can be mixed in other foods or in soups.

Mr. POLLOCK. Cookies and pancakes?

Mr. WATERS. Anything.

It has had a pretty universal acceptance as an easily prepared food. We are going to try to do the same thing with the fish protein concentrate. We are also using some new formulated foods with a what base that are getting fast acceptance. Under a modern food technology, you can start with the raw materials and build almost any type of food as long as you keep the cost down.

The unfortunate part of it is that until we can start mass production we will not have the lowest cost of a good protein concentrate.

Mr. POLLOCK. When do you visualize this plan will be completed for this mild price tag?

Mr. WATERS. We have taken a gamble ourselves by setting aside out of fiscal year 1968 funds—and we certainly don't have any surplus of funds—$1 million for this purpose. We are working with the Department of Agriculture and people from the Bureau of Commercial Fisheries, Health, Education, and Welfare and others, to come up with the specifications of the food product that we can ask industry to produce with fish protein concentrate in it. We are going to try to do it in this fiscal year.

Mr. POLLOCK. When you come up with this coordinated plan, could you advise this committee and the chairman of this subcommittee?

Mr. WATERS. I would be glad to.

Mr. POLLOCK. We would all be very interested in that.

Mr. WATERS. Very good.

Mr. POLLOCK. Thank you, Mr. Chairman.

Mr. LENNON. Thank you, Mr. Pollock.

Mr. Waters, over how many hundreds of years has AID been involved in the worldwide food assistance program?

Mr. WATERS. Mr. Chairman, AID itself, Agency for International Development, was created by a combination of predecessor agencies in 1961, combining the old International Cooperation Administration and Development Loan Fund.

Mr. LENNON. I am speaking of AID as we know it now and predecessor organizations. How long has your organization, AID and predecessors in title, been actively engaged in the worldwide food assistance program?

Mr. WATERS. Ever since the start of any of these foreign assistance programs, primarily after World War II. It started with the Marshall plan days in Europe and Greece and Turkey assistance program, in one form or another as food assistance has been developed. The food assistance programs took a large expansion in 1954 with the enactment of Public Law 480. That is funded out of Department of Agriculture funds.

The overseas administration and planning use of that is coordinated and handled through the AID agency but it is done on an interagency basis with the cooperation of the Department of Agriculture.

Mr. LENNON. The reason I ask that question is to get the record as complete as we could, because you make the statement about AID food assistance program, as programs undertaken in cooperation with the U.S. Department of Agriculture under the Food for Freedom Act of 1966. The inference to the outsider is that you became involved in a worldwide food assistance program under the Food for Freedom Act of 1966. That is not the substance of that?

Mr. WATERS. That is right.

Mr. LENNON. Then you go on to say, "The proposal on which we are working actively is to use the domestically produced FPC to enrich wheat or a combination of grains provided by the Commodity Credit Corporation," and so forth and so on.

Are you speaking there in terms of domestic U.S. production of FPC?

Mr. WATERS. Yes, sir.

Mr. Chairman, if I may explain, I think it may clarify that somewhat. Our problem has been how to blend together some of the AID appropriations and the Department of Agriculture appropriations to come out with what we want to achieve.

After Public Law 480 was enacted in 1954, the direction of Congress was that we should use the availability of food under that act rather than our direct aid money to buy food products, rather than having duplication of effort in Government funding of food products. Unfortunately, the Department of Agriculture has had no provision for funding fisheries products.

As a result of that, fish products were not included in our food assistance efforts.

Mr. LENNON. The Department of Agriculture and the administration have at no time in history asked for this legislation to permit that?

Mr. WATERS. That is right. No funds are provided by the Department of Agriculture.

Mr. LENNON. We cannot put the responsibility there on the Congress, because the administration didn't ask for what you indicated we didn't have?

Mr. WATERS. That is right.

Mr. LENNON. I assume that you are familiar with Public Law 89–701 which was signed into law and became Public Law 89–701 on November 2 of last year; are you familiar with that public law?

Also, you are familiar with the conference report which preceded the acceptance of that bill by both branches of the Congress? You recollect that in that law the Secretary of the Interior was authorized to conduct grants-in-aid and contract with public and private agencies to promote studies, experiments, and so forth, in the development of the most economical process and method to produce.

Getting back to FPC, can you tell us how many contracts, how many grants have been made under the authority of this law by the Secretary of the Interior for this purpose?

Mr. WATERS. Mr. Chairman, I could not answer for the Secretary of Interior on this. None to AID. In fact, it is the other way. We have provided money to them to expedite the program.

Mr. LENNON. I want to ask the counsel to direct a series of questions, which would follow the hearings by these gentlemen from the Bureau of Commercial Fisheries, particularly the Secretary of the Interior, as to the implementation of this act since it became law on November 2 last year.

Of course, you do not know whether the law also authorized the Secretary not to exceed one experimental demonstration plant for the FPC and also to operate and maintain a contract for operation of up to five others. We authorized funding both in the acquisition and also for the contracting up to five others. I believe it was for this purpose.

We would like to make inquiry with respect to that, too, Mr. Counsel.

There was an inhibition with respect to this legislation that the Secretary of the Interior shall not commence construction on these pursuant to the provisions of this act until the Secretary of Health, Education, and Welfare—we were so delighted to have him represented here this morning—shall certify that fish protein concentrate produced from whole fish complies with the provisions of the Federal Food and Cosmetics Act.

Do you know whether or not the Secretary of Health, Education, and Welfare certified to the Secretary of the Interior that fish protein concentrate produced from whole fish complies with the provisions of the Federal Food and Drug and Cosmetic Act? Can you answer that?

Mr. PARMAN. I would assume so, because they publish regulations in the Federal Register.

Mr. LENNON. I want to ask the counsel, have we been advised of that?

Mr. EVERETT. I think it has been certified.

Mr. LENNON. That will be included at this point in the record, a copy of that certification.

(The following correspondence took place in response to the above request:)

DECEMBER 15, 1967.

DR. STANLEY A. CAIN,
Assistant Secretary of the Interior,
Department of the Interior,
Washington, D.C.

DEAR DR. CAIN: As you are aware, our Subcommittee on Oceanography has been holding a series of hearings on the implementation of the National Marine Sciences Program. On Friday, December 8, the Subcommittee was privileged to receive testimony from the Honorable Herbert J. Waters, Assistant Administrator for War on Hunger, and Mr. George Parman, Director, Food from the Sea Service, both of the Agency for International Development.

In the interest of time, Chairman Lennon asked me to submit a series of questions to you in writing concerning the implementation of the Fish Protein Concentrate Program, authorized by Public Law 89–701. I sincerely feel that additional information with respect to this program is needed to complete the record of these hearings. Following are the questions to which I wish you would supply your comments:

1. Public Law 89–701 authorized the construction of one experiment and demonstration plant and the leasing of an additional plant for the production of fish protein concentrate. Has the contract been awarded for the construction or leasing of these plants? If so, where would they be located? Also, provide general information which would be useful to the Committee concerning locations, and terms and conditions of any contract entered into.

2. How much has been appropriated to carry out this program for fiscal year 1968 under Public Law 89–701 as well as any other law?

3. When do you contemplate production will begin from either or both of these plants and how many pounds of fish protein concentrate do you anticipate will be produced per annum?

4. With respect to the experiments being conducted at the plant operated by the Bureau of Commercial Fisheries at Beltsville, Maryland, what other species of fish are being experimented with at the present and with which species you planning future experiments? Also, indicate if experiments are being conducted—or contemplated—with any process other than isopropyl alcohol.

5. The last sentence in Section 2 (a) of Public Law 89–701 provides as follows: "The Secretary of the Interior shall not commence construction of or lease any plant pursuant to the provisions of this Act until the Secretary of Health, Education, and Welfare shall have certified that fish protein concentrate produced from whole fish complies with the provisions of the Federal Food, Drug, and Cosmetics Act." Please provide the Committee with a copy of the certification submitted by the Secretary of Health, Education and Welfare to the Secretary of the Interior.

6. Advise the Committee of other provisions of law, if any, under which the Secretary of the Interior is carrying out fish protein concentrate research, and to what extent.

7. Section 4 of Public Law 89–701 makes it mandatory that the Secretary of the Interior cooperate with public and private agencies, organizations, institutions, and individuals in carrying out the program authorized by this Act. Advise the Committee as to what extent this section of the law is being utilized and to the efforts being exerted by these other agencies and industry in furthering this program.

8. How do you propose to utilize the fish protein concentrate produced from the plants authorized by Public Law 89–701? Will the finished product be sold, used in furtherance of Public Law 83–480 or the Food for Freedom Act of 1966? If sold—domestically or foreign—what do you propose to do with the revenues?

9. Would you supply for the record the estimated cost of producing fish protein concentrate on a per pound basis and the estimated cost of raw fish to be utilized. Also, indicate the areas where such species are prevalent.

Thank you for supplying the Committee with your comments.

Sincerely,

JOHN M. DREWRY,
Chief Counsel.

U.S. DEPARTMENT OF THE INTERIOR,
OFFICE OF THE SECRETARY,
Washington, D.C., January 25, 1968.

MR. JOHN M. DREWRY,
Chief Counsel, Committee on Merchant Marine and Fisheries, House of Representatives, Longworth Office Building, Washington, D.C.

DEAR MR. DREWRY: This is in further reply to your letter of December 15, 1967, concerning the information required by your Subcommittee on Oceanography to implement the National Marine Sciences Program. We are pleased to provide you with the enclosed report.

The questions you posed are answered in the order expressed in your letter. Question five requests a copy of the certification by the Food and Drug Administration showing that fish protein concentrate complies with the provisions of the Federal Food, Drug and Cosmetic Act. We are expecting to receive a copy of this certification from the FDA in the near future, and at that time it will be forwarded to you.

Sincerely yours,

CLARENCE F. PAUTZKE,
Deputy Assistant Secretary of the Interior.

Enclosure.

RESPONSE TO QUESTIONS ON BUREAU OF COMMERCIAL FISHERIES FPC PROGRAM

Q. 1 (a). Has the contract been awarded for the construction or leasing of the plants authorized in Public Law 89–701?

A. The contract for design, construction, and operation of a plant has not yet been awarded. Several firms have submitted proposals in response to the Bureau's Request for Proposals and negotiations are essentially complete.

Q. 1 (b). Where will the plants be located?

A. Prior to receipt of proposals the Secretary announced that the constructed plant would be located in the Pacific Northwest. The exact site will be determined at the conclusion of negotiations with the successful proposer.

Q 1 (c). Provide general information which would be useful to the Committee concerning locations, and terms and conditions of any contract entered into.

A. The Bureau proposes to enter into a contract in the near future on the basis of cost reimbursement plus a fixed fee to design, construct, and operate the FPC plant. It is intended that the contract would authorize the contractor to proceed only with the design of the plant. Notices to proceed with acquisition of equipment will be separately issued later as parts of the design are completed and equipment decisions are reached, provided that such notices will not create an obligation in excess of the funds when available. We do not intend to authorize actual construction prior to completion of the needed authorizing legislation and appropriation action.

Q 2. How much has been appropriated to carry out this program for fiscal year 1968 under Public Law 89–701 as well as any other law?

A. The sum of $2,564,000 was appropriated in fiscal year 1968 for the fish protein concentrate program. This includes $429,000 for continuation of FPC research program underway prior to the enactment of Public Law 89–701, $1,135,000 for carrying out the research and plant operating provisions of Public Law 89–701, and $1,000,000 for design and construction of an experiment and demonstration plant.

Q 3 (a). When do you contemplate production will begin from either or both of these plants?

A. Production from the constructed plant will begin about 18 months after the contract has been signed.

Q 3 (b). How many pounds of fish protein concentrate do you anticipate will be produced per annum?

A. It is difficult to anticipate the output on the FPC plant because it will not be used wholly for production purposes. Instead, it will be involved in many different types of experiments and demonstrations which will require start and stop operations.

A. In an effort to quantify production estimates, an assumption can be made that the plant might operate a total of 3,200 hours during the first year. Under these circumstances, 2,200,000 pounds of FPC would be produced. Such an assumption would be based on a production schedule of 24 hours a day for 5 days a week during 3½ months of peak fish harvesting. This would demonstrate the feasibility and costs of fulltime operation. During the remainder of the year, 8½ months of experimental runs of 8 hours a day for 5 days a week might be scheduled.

A. If the plant were to be run on a full capacity basis for 24 hours a day for 250 days a year, 4,100,000 pounds of FPC should be produced.

Q 4 (a). With respect to the experiments being conducted at the plant operated by the Bureau of Commercial Fisheries at Beltsville, Maryland, what other species of fish are being experimented with at the present and with which species are you planning future experiments?

A. Atlantic red bake has been the principal species studied to date. Very limited work has been done on Pacific hake. Work on fatty fish is scheduled for the future which will lead to the development of a petition to the Food and Drug Administration for approval of these species.

Q 4 (b). Indicate if experiments are being conducted—or comtemplated—with any process other than isopropyl alcohol.

A. Experiments are not being conducted by the Bureau with processes other that isopropyl alcohol, except for a very preliminary study on screening enzymes for potential use in an enzymatic digestion process. Experiments are contemplated with processes that include:

1. Solvents other than isopropyl alcohol,
2. Enzymatic digestion processes, and
3. Shipboard applications of the processes.

Q. 5. Please provide the Committee with a copy of the certification submitted by the Secretary of Health, Education, and Welfare to the Secretary of the Interior.

A. There is attached a copy of a letter dated May 26, 1967, from the Deputy Assistant Secretary for Science and Population, Department of Health, Education, and Welfare, which supports our position that the certification requirement of Public Law 89–701 had been met. However, to avoid any misunderstanding, we have recently requested the Secretary of Health, Education, and Welfare to furnish a specific certification. It will be forwarded to the Committee upon receipt.

Q. 6. Advise the Committee of other provisions of law, if any, under which the Secretary of the Interior is carrying out fish protein concentrate research, and to what extent.

A. Our past research was conducted under the Saltonstall-Kennedy Act of July 1, 1954, as amended (15 U.S.C. 713), and under the Fish and Wildlife Act of August 8, 1956, as amended (16 U.S.C. 742). In fiscal year 1968, $429,000 was appropriated under provisions of the Fish and Wildlife Act of August 8, 1965, as amended, and $2,135,000 was appropriated, including $1,000,000 for construction, under the provisions of Public Law 89–701.

Q. 7. Section 4 of Public Law 89–701 makes it mandatory that the Secretary of the Interior cooperate with public and private agencies, organizations, institutions, and individuals in carrying out the program authorized by this act. Advise the Committee as to what extent this section of the law is being utilized and to the efforts being exerted by these other agencies and industry in furthering this program.

A. The Department is cooperating with many public agencies, organizations, institutions, and individuals in carrying out the FPC program. A principal example of this is our cooperative program with the U.S. Agency for International Development Food From the Sea Program. As part of this effort, the Bureau has provided technical assistance and personnel to assist in the overseas FPC development.

A list of many other agencies, organizations, and institutions with which we have cooperated follows:

1. The President's Council on Marine Resources and Engineering Development.
2. The Commission on Marine Science, Engineering and Resources.
3. The National Academy of Sciences.
4. The Food and Drug Administration.

The private sector and educational institutions have also assisted through contract efforts. Among the contractors are:

5. The Massachusetts Institute of Technology.
6. The University of California.
7. The University of Louisville, Kentucky.
8. Columbia University.
9. Esso of New Jersey.
10. Artisan Industries.

The private sector will also design, construct and operate the experiment and demonstration plant under contract to the Bureau as described in No. 1, above.

Q8(a). How do you propose to utilize the fish protein concentrate produced from the plants authorized by Public Law 89–701?

A. The major use of the product will be in U.S. AID market development programs for human feeding studies. It will also be used by Bureau scientists and by private industry in food development and formulation studies.

Q8(b). Will the finished product be sold and used in furtherance of Public Law 93–480 or the Food for Freedom Act of 1966? If sold—domestically or foreign—what do you propose to do with the revenue?

A. There are no present plants to sell the finished product. It will be provided to the Agency for International Development in connection with its program of food donation to critical areas of the world and, if the supply is sufficient, to other agencies such as UNICEF, FAO, and WHO for use in conducting programs on protein rich foods. Samples will also be provided to private industry for use in product research to develop low-cost, high-quality foods supplemented with FPC. If supplies are such to warrant disposal of some by sale, the proceeds will be deposited into the Treasury as miscellaneous receipts.

Q9(a). Would you supply for the record the estimated cost of producing fish protein concentrate on a per pound basis?

A. FPC will cost approximately 25 cents per pound at the consumer level. This estimate is based on the continous operation of a full-scale commercial plant. Such a plant can produce FPC for a processing cost of about 7 or 8 cents per pound. Assuming a cost of raw fish of from 1 to 2 cents per pound, the final FPC would cost between 13 and 19 cents per pound. Adding 6 cents a pound for packaging and distribution costs and for profit, an FPC product might cost about 25 cents per pound.

Q9(b). What is the estimated cost of raw fish to be utilized?

A. We have been using an estimate of $40 per ton or 2 cents per pound for raw hake delivered to a Pacific Northwest demonstration plant. This figure is, of course, subject to considerable market fluctuations, but hake has been delivered in this price range and lower in the past. In many parts of the world, raw fish are delivered at less than 1 cent per pound.

Q9(c). Indicate the areas where such species are prevalent.

A. Areas where species to be used for FPC are prevalent are:

1. Alaska—Alaska Pollack.
2. Pacific Northwest and California—Pacific Hake.
3. North Atlantic Coast—Red Hake, Squirrel Hake, Silver Hake (Whiting).

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE,
Washington, D.C. May 26, 1967.

MR. H. E. CROWTHER
Director, Bureau of Commercial Fisheries,
Fish and Wildlife Service,
Department of the Interior,
Washington, D.C.

DEAR MR. CROWTHER: This is in response to your letter of May 25, 1967, concerning the provision of P.L. 89–701, which prohibits the Secretary of the Interior from commencing construction of the authorized fish protein concentrate demonstration plant until the Secretary of HEW provides an appropriate certification.

We assume, as you do, that the foregoing provision of P.L. 89–701 has been met by the February 2, 1967, Food and Drug Administration amendment regarding the use of fish protein concentrate. We shall, however, be pleased to provide you with an appropriate certification if you determine it to be necessary or desirable.

No hearings have been scheduled with respect to the February 2, 1967, amendment to the food additive regulations, and it is our current intention not to stay the amendment in the event hearings should be scheduled.

I trust this information will be satisfactory for your purposes.

Sincerely yours,

MILO D. LEAVITT, JR., M.D.,
Deputy Assistant Secretary
for Science and Population.

Mr. LENNON. I have not been advised of it.

So until the certification from the Secretary of Health, Education and Welfare is made to the Secretary of the Interior, that having been done, the Secretary of Interior, under the mandate of this act can proceed according to the language of the act.

Just how serious a problem does the world face in protein malnutrition from the broad spectrum?

Mr. WATERS. Mr. Chairman, it is a very serious problem. In regard to the availability of food in relation to the numbers of people, the situation has been deteriorating for 2 years. The per capita availability of food has slipped rather than moved ahead.

While we are concerned with all the aspects of food availability, we are becoming more concerned about quality rather than just quantity. What we have learned more about in the last few years is the devastating effects of malnutrition, malnourishment, and we are increasingly concerned about this in the world. This is observed primarily in the young children. Most of our health authorities in our health programs assure us that the single greatest thing that can be done for improving the health of the world is better nourishment of children.

While the statistics in the world on child mortality may show deaths caused by simple, normal childhood diseases, the real truth is that the children are so undernourished that they die of disease that our children toss off without any problems. The death rate that can be attributed to malnutrition is increasing. The world is getting seriously concerned about it.

This is reflected in increased attention by all the international organizations, U.N., health organizations, Food and Agricultural Organization of the United Nations. It became serious enough for the President to make this the major direction of our foreign assistance program. We have given the highest priority of all of our foreign assistance activities to the broad area of the war on hunger.

We regard the war on hunder as covering not only meeting the immediate requirements through the use of our food assistance programs, but in a broader sense of encouraging increased agriculture production, increasing nutritional education, encouraging child-feeding programs, and instituting the new effort to make greater use out of the resources of the sea.

This new part, in fact the assignment to us from the Marine Council, was brought into being at the same time as the creation of a new Office on War on Hunger Agency for International Development.

Mr. LENNON. The interest of AID in this particular field we are discussing came in the fish protein concentrate project. You indicated in the statement this came from the enactment into law of what is now referred to as a Marine Resources and Fish Development Act of 1966, signed into law June 1 of last year. You folks have not been involved or engaged in any aspect of this before that time?

Mr. WATERS. We had started earlier with creation of a Nutrition Division in our Health Service. We had started exploration of what might be done with fish protein concentrate, but we are not sure what our role was compared with other departments and agencies of the Government. It was the Marine Resources Council, set up under the act created by the Congress, that first brought to a head the coordination necessary to assign responsibilities. They assigned us as the lead agency on the fish protein concentrate, but in coordination with the Bureau of Commercial Fisheries.

Mr. LENNON. I suppose it is of interest to you gentlemen, since your mandate is coming from the national council established under this act—I suppose, too, that you gentlemen are interested in the extension of the life of the council because you know under the official act they phase out 120 days after the Presidential Commission makes its report. You might encourage our counterparts in the Senate to act on this legislation this next week, if you can, because the House passed it unanimously last Monday.

Mr. WATERS. I assure you that it has been a very effective instrumentality in prodding and coordinating and stimulating activity throughout Government.

Mr. LENNON. You would not have a legislative mandate or guidance if the national council phased out under the act of the law?

Mr. WATERS. Our own new act, just enacted, now contains a section that tells us to get busy and do what we started to do under the original mandate.

Mr. LENNON. I believe it is a little belated but I am glad it is here. What countries now produce fish protein concentrate?

Mr. PARMAN. The only places where fish protein concentrate is being produced at the present time in any way approaching what could be called a good fish protein concentrate, is Chile, which has a small plant put up by UNICEF. That plant has had a very rough and stormy life.

Mr. LENNON. Is it producing fish protein concentrate now?

Mr. PARMAN. They are running it a little right now.

Mr. LENNON. The problem was the inability to market it?

Mr. PARMAN. It was inability to market. They were using it in giveaway programs and did not have any idea how they were going to market it.

Mr. LENNON. Related to the commercial production of other crops, a mix?

Mr. PARMAN. It was not even considered what they would do with the output. They made some very bad mistakes.

Mr. LENNON. Did they not have that experience in South Africa?

Mr. PARMAN. The product they made down there I wouldn't call fish protein concentrate. It was a slightly cleaned up fishmeal. You could smell it about 10 feet off.

Mr. LENNON. It was not acceptable?

Mr. PARMAN. It was not acceptable.

Mr. LENNON. Therefore not successful there?

Mr. PARMAN. There is also a plant in Morocco put up by a bilateral agreement with the Moroccan and French Governments which turned out quite a bit of product until it was found that no one knew what to do about marketing the output. The plant is idle at present.

Mr. LENNON. Is there anywhere in the world today, any nation in the world, I am sure you gentlemen would know, where fish protein concentrate is widely accepted?

Mr. PARMAN. Not on a commercial basis. It has been widely used in countries like Chile and Peru. There have been some interesting experiments done with fish protein concentrate. They have got some very interesting results but it is not used commercially.

Mr. LENNON. We come back then to what you said originally, Mr. Waters. If fish protein concentrate is produced here; that is, blended with wheat and other grains, AID proceeds through the Commodity Credit Corporation for export overseas, that is about the only way to create a market for it?

Mr. WATERS. We see that as the most immediate way. Once we have the acceptability and educational value that goes with such use, we may develop other approaches to it. I have had discussions with representatives of a number of other governments facing somewhat the same problem. At a recent session of the FAO in Rome, Scandinavian countries said they were hoping to start some activities of this kind. They ran into the same problem of trying to encourage other developing countries to accept a fish protein concentrate-type product. "If the United States is not willing to accept this for its own use, we are not convinced it is safe," they were told.

There is an educational job yet to be done. That is why we feel that we have to move a bit cautiously but we want to build a sound program and not have it bogged down by some of the experiences of the tries made in the past. We are trying to ——

Mr. LENNON. I take it then that you are going to be constrained in encouraging construction of plants overseas, particularly in the areas where this fish protein concentrate product is needed until such time as it is marketable or at least acceptable, if not marketable?

Mr. WATERS. That is right. We want the demand itself to bring the interest of financing the plants rather than just build plants and see if we can ——

Mr. LENNON. You have to sell the product before you can take the risk of AID funds and fish protein concentrate plants overseas?

Mr. WATERS. That is right.

Mr. LENNON. Plants are built here under the act passed last year, and must meet FDA standards, as I understand it; is that correct?

Mr. WATERS. That is right.

Mr. LENNON. What other type of fish other than hake can be used satisfactorily under the accepted standards that Food and Drug just approved.

Mr. PARMAN. Strictly speaking, only members of the hake family.

Mr. LENNON. I am advised that some 25 percent of most of our commercial fish catches are wasted. Do you have any facts on that?

Mr. PARMAN. Well, I cannot speak to that particular question; but I know that one of the areas of research we must get into is on the utilization of wasted catches both here and overseas as a source for fish protein concentrate, and to get the data necessary to convince the regulatory bodies that this is a safe product.

A very typical example of that is in the shrimp-catching areas. They often catch as much mixed fish as shrimp. The great majority of that is thrown overboard. If that could be converted to fish protein concentrate, there would be an economic gain.

One thing we have to consider in the fish protein concentrate business is a cheap source of fish. We cannot use expensive fish. We have to use something caught cheaply and in large quantities.

Mr. LENNON. I do not suppose you could single out America or India or Africa where this product is needed most, could you?

Mr. PARMAN. I am sorry, I didn't get the full question.

Mr. LENNON. I do not suppose you could single out any specific area in the world where such a program is needed most?

Mr. PARMAN. The demonstration countries, which we are in the process of picking out, have as one of the criteria we use, the need for such a program.

Mr. LENNON. It has also been attempted to use this in India?

Mr. PARMAN. It has been worked a little bit. But in India you have a very difficult problem. I have had a number of months' experience in India and I don't have an answer to it. That is the problem of vegetarianism, which does not occur in pockets, but broadly throughout the population.

Mr. LENNON. Where it is really needed most it is somewhat unlikely to be accepted generally?

Mr. PARMAN. Yes. The true vegetarian Hindu won't touch it.

Mr. LENNON. Even though a small percentage of them are acquainted with other products?

Mr. PARMAN. Yes, sir.

Mr. LENNON. I do not suppose there is any danger in the use of the product, getting a higher percentage of it blended with your grain cereals and other things of that kind?

Mr. PARMAN. No, sir.

Mr. LENNON. I think we can recognize the gentleman from Alabama.

Mr. EDWARDS. I have been learning a lot but I have no questions, Mr. Chairman.

Mr. LENNON. I wonder, gentlemen, if there is any additional information that you would like to add to what you said here. We would be delighted to have it for the record because the committee was tremendously interested in the hearings last year on the passage of the so-called fish protein concentrate bill. We would like to know if you have anything further.

I am advised that on this problem AID will announce the country selected for the U.S. fish protein concentrate experiment sometime within maybe a month or two.

Mr. Waters. Mr. Chairman, we hope to have it by the first of the year. That is our aim and the timetable. We have kept to it so far.

Mr. Lennon. Without naming the country, we have no business knowing that at this time until the decision is made; but what phase of this program will this country have? Will you try to get them to accept the philosophy of the fish protein concentrate blended with our grain, a cereal that will come from the Commodity Credit Corporation through the distributorship of AID? Is that the way it will be done?

Mr. Waters. No, sir.

Mr. Lennon. What do you mean?

Mr. Waters. Our first move was a reconnaissance survey. The teams have been out. The reconnaissance surveys took into account a number of factors. The interest of a country, the need, technical availability of the fish, trying to decide in what countries we want to go into the situation in more depth.

The demonstration studies starting next will be really an indepth study, going to selected countries where we have the cooperation of the officials of a country and a known interest and a belief that we have economic availability of fishing. Then we will do the more indepth feasibility study of marketing aspects to see if we can prove the commercial market exists enough to try to attract investment of private enterprise.

Entirely aside from the demonstration studies that will be going on, we will move ahead independently with the demonstration of our own product from this country and made available within our food for peace program, and introduce that into just as many countries as we can. The introduction of the blended products, using FPC from this country, will not be limited to the demonstration countries. It will be made available as rapidly as possible on a worldwide basis.

Mr. Lennon. Mr. Waters, in Southeast Asia, Vietnam, particularly in the south, the principal staple is rice. But fish plays a substantial part in the diet of the Vietnamese; isn't that true?

Mr. Waters. That is true.

Mr. Lennon. At least that is what I read.

What is the total economic assistance under AID for fiscal year 1968 for South Vietnam?

Mr. Waters. I would have to provide that for the record, Mr. Chairman. It is very, very substantial.

Mr. Lennon. Very substantial.

Off the top of your head, do you want to give us a figure, with the privilege of correcting it for the record? I do want it precise when you get it for the record.

Mr. Waters. I would hesitate to give you that, Mr. Chairman. I am only indirectly involved in the food and agriculture aspects.

Mr. Lennon. It runs some several hundred million.

What percentage of their diet is fish in South Vietnam?

Mr. Parman. It varies greatly, depending on the districts, the area. They have for centuries done a lot of fresh water fish farming, using carp and perch as the main fish. They have become quite adept at this. From the standpoint of marine fisheries, the principal use aside from the coastal use of the fisheries, is making fish sauce which is interestingly enough a form of protein concentrate where fish is fermented in large jars for up to 6 months to a year and drawn out as a very piquant liquid, which they add to their food, much as soy sauce. Surprisingly, it makes a very important contribution to their protein.

Mr. LENNON. Indeed it does. I wonder how we are going to take an infinitesimal part of your total economic aid for the fiscal year 1968, or total of $320,000, and do what you propose to do that you set forth in paragraph 2 on page 2. That is less than one-hundredth of 1 percent, I am sure, of your total economic aid to South Vietnam. Having done a little research work recently with respect to the impact on its economy and fishing and its use in Vietnam, I wonder why you folks did not allocate a funding level of more than $320,000 for this purpose to train Vietnamese in modern fishing technology, production and distribution, construction of fishponds, distribution of fishing boats, construction of ice plants and processing.

Construction costs are pretty high over there. You cannot build a fishpond in the United States today, a substantial one, just one big fishpond, for much less than that.

I wonder why there is such an infinitesimal part in the total allocation for economic assistance to South Vietnam in fiscal 1968 allocated to this important phase of their livelihood, survival nutritionally?

Mr. WATERS. I would agree with you, Mr. Chairman, this seems very insignificant in view of the total Vietnam program. However, this amount is technical assistance in support of these activities.

Mr. LENNON. I wouldn't call actual construction of fishponds, the building of fish landing facilities and bodies and gear, that is not technical assistance, but you include that in your statement as to what the $320,000 could be expended for. This is not research; that is facilities.

Mr. WATERS. This is providing the technical assistance for these facilities.

Mr. LENNON. If you could have a news reporter follow you folks around over there to see what you are trying to do to upgrade their standard of living with something they use so greatly, maybe we wouldn't have these demonstrations that we are having around the clock now.

Mr. WATERS. I would agree, Mr. Chairman.

I would agree that there has been a lack of emphasis on the fisheries side of our aid activities over the years. I think the new impetus brought about by the Marine Council should bring about a change.

(The following information was supplied in relation to the above:)

VIETNAM FISHING PROGRAM

Fishing provides an important source of protein for the Vietnamese diet. Eaten with rice, Vietnam's principle food source, fish accounts for between 7 percent and 10 percent of Vietnamese food expenditures.

In spite of severe restrictions placed on the fishing industry by security conditions in South Vietnam, the annual catch has increased from 165,000 metric tons in 1959 to the current level of approximately 400,000 tons. Offshore fishing has been seriously restricted because of military actions but has improved its yield through adoption of modern techniques advanced by AID and GVN fishery advisers. At the present time there are 79 fishing cooperatives with a total membership of more than 17,000 people.

There is now a 3,000 fingerlings capacity in Vietnamese hatcheries. Throughout the country 27 million fingerlings have been distributed to local fish ponds. Even for fresh water fish ponds security has been a limiting factor to any expansion program.

The total economic assistance provided to South Vietnam by AID in FY 1968 is expected to be $490 million. Of this, $270 million is directed to the project program through which technical assistance and commodity support is provided to the government of Vietnam for its civilian programs.

AID's principle efforts in the agriculture area for the coming year will be to greatly increase production of rice and protein foods. Included in the protein category are pork, poultry, and fish. The goal established by AID for output in these three protein sources is a 10 percent increase annually during the 1968–1971 period. For fish production the emphasis will be on supplying improved equipment (boats, engines, nets, etc.) to fishermen in greater quantity and on better terms. Effort will be extended to improve credit to fishermen and their organizations. The nature of the fishing industry in Vietnam is such that large inputs of dollars are not required to achieve the hoped-for goals. This is apparent from the large increase in fish yield during the past eight years with relatively small dollar inputs but considerable technical advice and improvement in procedures. Fishing is a family oriented private enterprise venture in Vietnam.

In FY 1967 for the fishing industry, the program grew rapidly to a planned level of $358,000, of which $207,000 was expended by the end of the year. The program for FY 1968 is expected to cost $356,000 while next year's program will increase to $412,000.

Mr. LENNON. I think it would be very interesting to go to the floor of the House and the Senate and get the figures for 1968 for economic assistance allocation of funds. Most Congressmen know what high portion fish are to the diet, and point out that we are spending several hundreds of millions of dollars over there but we can only spend a few thousand dollars for the basic diet of these people.

Mr. ROGERS. I have read your statement and I, too, hope you will put greater emphasis on developing this program. It seems to me we are far behind.

How do our efforts compare with Russia?

Mr. WATERS. In the assistance field?

Mr. ROGERS. Yes; but developing the food from the sea, the fish protein.

Mr. WATERS. I pass that to Mr. Parman.

Mr. PARMAN. Mr. Congressman, that is a little difficult but I will do what I can on it. If you are talking about what they are doing for their own needs——

Mr. ROGERS. Not only for their own needs; perhaps you could comment on that, however.

Mr. PARMAN. Their own needs are quite obvious from what I have been able to see and study. They have undertaken a very deliberate program of greatly increasing their fishing capacity with most modern gear. They have floating factory ships which are fantastic and they are fishing the world seas. This fish is largely going back to Russia. They have done very little in terms of aid to other countries except to supply trawlers and fishing boats to some of the countries, particularly in the Gulf of Guinea in Africa. They have done quite a bit down there, but when Nkrumah got kicked out in Ghana the Russians were kicked out with him.

They have sold a lot of fish to the Africans on a straight commercial basis but I have not seen any evidence beyond that of any intensive program. They are keeping it for themselves. They are fishing the world markets and taking it home for their own use.

Mr. Rogers. They are using a great deal for themselves, particularly since they have had such difficulty with their own agriculture. To supply protein to the Russian diet they have turned to protein from the sea.

With regard to the Russian diet, it may not be so much of an aid program, but they are getting paid either in products or in actual money and they are sending these fishing fleets all around Africa and they can sell right there as they process the fish.

I think we are far behind what they are doing in this area, and certainly your agency can be helpful in bringing us a little more up to date. In fact, I would hope you would encourage our own industry to do this and that where they can sell it, it would be sold, and not necessarily just given away.

What is your attitude on that?

Mr. Parman. We have some ideas that we have been talking about with regard to developing a straight commercial venture in that African area which is going to take some money. It is not going to take just peanuts; it is going to take several millions to do it. You will need factory ships; you can't operate if you don't have that.

Mr. Rogers. I agree, we must modernize our fleets or we are just going to be run off the seas.

Mr. Parman. And we cannot just take a freighter and reconvert it. We are kidding ourselves if we do that. We have to have a ship that is a factory ship if it is to work at all.

Mr. Rogers. I think you are correct in that. I would hope you would keep this committee advised as you make progress.

Mr. Pelly. In that connection, of course, this committee initiated legislation to subsidize the construction of fishing vessels. Congress authorized, I think, $5 million last year for this program and it was awarded for the construction of two stern-ramp trawlers. It is a rather substantial sum for two ships, $5 million, and so far as I know they would not be able to process all of their catch. Maybe they could; I am not sure. As you say, it is going to take a lot of money when you think of the number of vessels needed. I would hope, however, that this requirement could be met by private industry and, if possible, without construction subsidies. We have a loan program so fishermen can borrow money and we have done everything we can within reasonable limits to try to expand our fisheries. Also, the Bureau of Commercial Fisheries has urged our fishing industry to make improvements and become competitive in offshore fishing areas.

Mr. Waters. With regard to encouraging the commercial people, I did emphasize our efforts to build soundly on a fish concentrate use program, but we feel very strongly it has to be a broader base than just using the food donation programs. We believe the food donation programs can be a valuable starting incentive and be a way of getting food acceptability, but we are very much concerned with getting it on the store shelves to build an industry rather than just creat something for a temporary Government-subsidized market. That is probably why we haven't made as fast progress as we had hoped. However, we are earmarking money to stimulate the domestic industry this year.

Mr. Rogers. Do I understand you to say you are buying now——

Mr. Waters. We have offered to buy up to $1 million worth of products this year, blended into a formulated product similar to the products we are now using from the Department of Agriculture. We are working out the final arrangements for how this will be carried to the trade and the chairman has asked that he be kept fully informed on this. When we reach our agreement, we will do that. We are offering to buy before we have the product available because we feel that is the only way we will get industry to start producing, but we are going to offer that as an inducement to industry in this country.

However; again, I emphasize that we are trying to build a market; establish a distribution channel and create a market, but the question of how fast the pilot plants can move and how fast industry can move, these are really other peoples' decisions and not really ours. I think our emphasis on it and our willingness to introduce it in our food programs, and our effort to encourage acceptability overseas, will be a major inducement to the industry in this country.

Mr. Rogers. I would agree with you. I think it is essential to get this industry started and moving.

To follow up my colleague's statement, I also think that anything that can be done to encourage our own fishing fleets to become modernized should tie in with this program of helping and also bringing dollars to this country. Certainly Russia is fishing the seas of the world, and they are going to start moving south now. They have already, of course, been fishing along our northern coasts, and they are now starting to move south. I think we will find them fishing all of the Caribbean and South America, and, of course, they will try to sell their products there just as they have in Africa. And this would take markets away from our own people if we don't develop our capacities to do this.

I commend you for your interest. I would hope that you would give increased emphasis to this whole area in your program and as the chairman has stated, the present emphasis of some 320,000 seems rather insignificant in comparison to the contribution that this could make and fit in with the economies of those nations.

Thank you.

Mr. Drewry. Mr. Waters, in connection with the question Mr. Pelly was raising with regard to the aid to development of fisheries in other countries, that we are sort of clobbering ourselves, you mentioned that it was something over which AID had no control. I believe you said AID can't do it alone. However, as chairman of the Food From the Sea Committee of the Council which has a membership from BCF, and others I am sure, why couldn't your committee do coordination in that area where these friction points arise? Couldn't you say, "All right, we need help in this direction." Couldn't you perform some coordination through this committee mechanism?

Mr. Waters. This is a good suggestion, Mr. Drewry, and I would be glad to put that on the agenda of one of our next Food From the Sea meetings.

The makeup of that Committee includes AID, the Office of Science and Technology, the Smithsonian Institution, the Council of Economic Advisers, the Department of Health, Education, and Welfare, the State Department, the Bureau of Commercial Fisheries.

There are other observers and consultants. It gives us a good cross-section to try out many of the policy implications in these suggestions.

Mr. DREWRY. That is the thought I had in mind. I didn't know what you might be doing.

Just one other thing: Mr. Parman mentioned the FPC in Chile. Would that meet U.S. standards for being safe for human consumption?

Mr. PARMAN. I don't know whether it could or not. The plant itself, when I saw it, was not what I would consider too good a plant. The answer is probably No, but it might be approved.

Mr. DREWRY. We had no control over that at all.

Mr. PARMAN. This was strictly a U.N. operation.

Mr. DREWRY. When the time comes when you are producing or sponsoring the production of FPC in foreign sources with perhaps not only hake, but other things, when do you require that the products of the foreign facilities meet the U.S. standards?

Mr. PARMAN. Right now we are trying to get international standards set up for fish protein concentrate through the U.N. This is a helpful way of keeping a degree of control on the area and keeping poor quality products from entering the market. Until such international standards are established, we will follow the policy that any FPC program in which we have input as a Government agency—where we have a financial interest or are supporting in any way, the FPC must meet FDA standards, except for packaging requirements.

Mr. LENNON. We thank you for your attendance. I am sure you can see the interest of the committee in this subject.

Dr. Jacobs, Deputy Assistant Secretary for Science, Department of Health, Education, and Welfare.

Doctor, first of all, we want to apologize for the way that the schedule has developed here. Mr. Pelly, having had the opportunity to read your statement, has suggested that perhaps you would want to put your statement in the record and then be subject to any questions.

Now, I might say that I am prepared to stay here until 12:30.

STATEMENT OF DR. LEON JACOBS, DEPUTY ASSISTANT SECRETARY FOR SCIENCE, DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Dr. JACOBS. Mr. Chairman, I was going to make the same suggestion because of the lateness of the hour.

Mr. LENNON. Suppose you put your statement in the record and summarize it sufficiently so that we might get some points on which we might question.

Dr. JACOBS. I will try to do that.

(The prepared statement of Dr. Jacobs follows:)

STATEMENT OF DR. LEON JACOBS, DEPUTY ASSISTANT SECRETARY FOR SCIENCE, DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Mr. Chairman it is a pleasure to appear before you this morning to discuss the efforts of the Department of Health, Education, and Welfare in the marine science field. I understand that in this series of hearings you will eventually have heard testimony from all the various Departments and agencies of the Federal Government which contribute to the national effort in oceanography and the marine sciences. Although the programs and activities of the Department of Health, Education, and Welfare in this field are to a considerable degree not specifically targeted on marine science, we believe that they are both significant and highly worthwhile.

I will first describe the activities of the Department, then dwell in more detail on current developments in marine toxicology and pharmacology, in which I have personally been involved.

I might say at the outset that we in DHEW have now for some time participated in a most fruitful exchange of information with and through the Marine Sciences Council and its staff. This has given better coordination of our efforts with those of other Departments. It has also helped us to sharpen and expand our own activities.

As you know, the participation of the Department of Health, Education, and Welfare in activities related to the sea is particularly appropriate in the light of the traditional and historical role of the Public Health Service, which began as the United States Marine Hospital Service in 1789. Today, of the approximately 400,000 persons eligible for direct medical treatment in Public Health Service facilities, most are merchant seamen; members of the Coast Guard and the Coast and Geodetic Survey and their dependents are also eligible. The Public Health Service provides the medical staffing for the Coast Guard. It is also noteworthy that the Public Health Service has had responsibility for quarantine activities since 1878; and these activities have related historically in large part to transportation by sea.

Quite appropriately, then, it is in the Public Health Service that the Department carries on the principal portion of its activities related to the marine sciences. The Public Health Service carries on marine science activities both in its Bureau of Disease Prevention and Environmental Control—as a part of the Water Supply and Sea Resources Program—and in the National Institutes of Health.

The program of the Water Supply and Sea Resources Program is a direct part of marine science and technology. Historically oriented toward shellfish and the prevention of the transmission of disease and poisons to man through the consumption of shellfish, the program today is being substantially broadened to include fish and the more basic research necessary to an understanding of poisons and diseases found in the marine environment and their transmission through the food chain.

Among its principal responsibilities, the sea resources program is responsible for monitoring shellfish growing areas and certifying that the products of these areas meet health standards. On the request and at the expense of certain foreign governments, this service is being performel abroad with respect to shellfish to be imported into this country.

Research and technological effort is carried on both inhouse and at universities and other organizations under grant and contract. Subject matter ranges from basic work on the identity and characteristics of marine toxins, through research into the environment of shellfish-growing areas and the development of standards for the treatment of wastes discharging into estuaries, to the development of techniques for the depuration and handling of shellfish. The program provides technical assistance in eliminating pollution and the reopening of shellfish growing areas. In recent times, attention has been given to the gonyaulax and ciguatera toxins; to botulism occurring in connection with the preservation and packaging of smoked fish, as well as the presence in estuaries of *Clostridium botulinum* and other toxin-forming species; and to salmonellosis.

The Program maintains three specialized laboratory facilities, the Northeast Marine Health Sciences Laboratory at Narragansett, Rhode Island; the Gulf Coast Marine Health Sciences Laboratory at Dauphin Island, Alabama; and the Pacific Northwest Marine Health Sciences Laboratory at Gig Harbor, Washington. The latter is the newest and smallest of these activities, but has the advantage of location near the University of Washington, which I understand is undertaking planning for a significant marine science effort.

The Program also is supporting the education and training of manpower in the field. In 1967 training was provided for 125 administrators involved in shellfish sanitation. A small number of research training grants were also made available.

As you will have noticed, the activities of the Program have a dual aspect. On the one hand, they promote the health of the public through the prevention of disease, the improvement of the marine environment, and, incidentally, the identification of materials for possible pharmacological use. The other aspect is the promotion for additional utilization of available shellfish resources which might otherwise be hazardous for human consumption.

Among recent research accomplishments resulting from work supported by this program are the following:

Work on viruses in shellfish has elucidated the rate at which shellfish accumulate viruses, their location in the organism, and methods for eliminating them from the shellfish.

Some naturally occurring marine biotoxins have been substantially isolated and work is progressing on their identification and physiological action.

Anti-viral and anti-tumor properties have been demonstrated in shellfish extracts.

To turn to another part of the Public Health Service, the activities of the National Institutes of Health in the marine science field, related entirely to research, include no program targeted at the marine environment. Rather, the NIH activities which fall into the marine science field are a part of the overall NIH research program aimed at the acquisition of biomedical knowledge and the attack upon human disease. While the work which I will describe relates to marine science in a significant way, marine science as such is not a responsibility of the National Institutes of Health.

The largest segment of research done or supported by NIH and relating to the marine sciences consists of research performed on marine life—not for the primary purpose of expanding knowledge of the marine organism itself, but because of usefulness of the marine organism in expanding knowledge about man. Almost every one of the disease-oriented Institutes of NIH is involved in work on marine organisms. The following are illustrations:

Study of immune phenomena in lower forms of marine animals.

Research on the parasites of fish and shellfish to discover how they may serve as reservoirs or vectors of disease.

Projects on cell division, protein synthesis, and neoplasms of fish.

Projects on calcification and demineralization mechanisms in marine organisms.

Study of the cephalopod lens and its formation.

Studies on the developmental biology and uptake of chemical compounds by marine invertebrates.

Studies of marine mammals relating to their protein structure, blood flow, and salt and water balance.

There are many more such investigations.

NIH also is engaged in, or funds, marine science-related projects in nutrition (e.g., the studies of marine oils and their effects on plasma lipids when fed to man) and projects on antibiotics in the sea and on marine toxins.

NIH can also support marine science in other indirect ways. For instance, NIH sponsored an international symposium in January 1967 on Comparative Pharmacology; a large number of the papers presented at the symposium dealt with marine organisms or pharmacologically active substances derived from them. Also, institutions may apply for support for the construction of biomedical research facilities which may be used for marine-related scientific effort.

The research, technological, and scientific activities of the Food and Drug Administration in the marine science field are based on FDA's statutory responsibilities under the Food, Drug, and Cosmetic Act and its amendments; they relate largely to the disease and contamination problems encountered in performing its food regulation function. It is FDA's job to detect unsanitary food, injurious, poisonous, or dirty substances in food, and unhealthful packaging, and to remove the "adulterated" product from interstate commerce. FDA does not have authority to develop marine resources.

In this context, FDA has conducted scientific and technological research on a wide variety of problems related to the healthfulness of marine food products. The following are examples:

Sanitation and decomposition.

Disease-producing viruses and bacteria in marine foods.

Presence of pesticide and antibiotic residues, trace elements, and other products in marine foods.

Possible toxic agents in smoked fish.

The activities of FDA in the marine science field to some extent fall within areas of investigation in which the Public Health Service is also engaged.

One of the significant acts of the FDA during this past year was to approve fish protein concentrate, or FPC, as a food additive when produced from hake-like fishes under certain designated processes. Applications for approval of other processes for producing FPC are likely, and FDA will continue to focus on any health problems associated with them.

As is the case with FDA and NIH, the programs of the Office of Education are not directed specifically toward the encouragement of marine science or marine science education, with a single exception. In the wide range of programs administered by the Office of Education are various ones supporting education in the marine sciences along with other sciences and other fields of learning. Scholars and institutions seeking support from OE in the marine sciences will find assistance based upon the quality of their proposals and activities.

The single exception referred to above is the program specially authorized for training in occupations in the maritime and fishing industry under the George-Barden Act.

Other programs under which support has been provided for marine science and engineering are the following:

> Graduate fellowships under Title IV of the National Defense Education Act to prepare for teaching careers in colleges and universities. In fiscal year 1968, 49 fellows are being supported in oceanography, marine science, and marine engineering.
>
> Grants for supplementary education centers and services under Title III of the Elementary and Secondary Education Act. These grants aimed at stimulating and assisting in the development of exemplary elementary and secondary school model programs currently include 8 projects in marine science education.
>
> Grants and loans for construction of undergraduate and graduate academic facilities under the Higher Education Facilities Act.
>
> Support for educational research, surveys, demonstrations, and dissemination of information derived from educational research under Title IV of the Elementary and Secondary Education Act.
>
> Financial assistance in acquiring special equipment under Title VI–A of the Higher Education Act.

Although support under the foregoing authorities for marine science—as distinct from other educational fields—is sometimes hard to identify, and indeed a small part of overall programs, it is important to keep in mind that these resources are available.

As I mentioned earlier, I would like to discuss in somewhat more detail current activities in marine toxicology and pharmacology. An *Ad Hoc* Committee on Marine Toxicology and Pharmcology was formed last May at the instance of the Marine Science Council. It currently has members from a number of agencies outside this Department—the National Academy of Sciences, Agency for International Development, Bureau of Commercial Fisheries, and National Science Foundation—as well as from the National Institutes of Health and the Bureau of Disease Prevention and Environmental Control. I am the current chairman. Although this Committee originally had a limited charter and tenure, it is broadening the subject matter of its interests and its activities and becoming more or less permanent. We anticipate a useful role in identifying needs and opportunities for research in marine pharmacology and toxicology, in stimulating and encouraging research in the organizations represented by our members, and generally in providing a focal point for information on the Government's activities in marine pharmacology and toxicology.

One major stimulus to effort on marine toxins is the current development of fish protein concentrate. Although marine toxins are not found in the hake-like fishes from which FPC will first be produced in this country, we must anticipate that the projected increase in world population and the anticipated deficiency of protein sources will lead eventually to consideration of FPC production from fish catches made in tropical waters in which toxins will sometimes be found. Thus, several types of research relating to these toxins can properly claim our attention today, to preclude any possibility of human toxification from FPC when the process of production is exploited more widely. Apart from FPC, we must also expect greater use of unprocessed fish in all parts of the world as the need for protein becomes more acute.

We foresee the following elements in marine biotoxin research:

> Acquisition and analysis of research results up to the present, in Japan and other foreign countries as well as in the United States.

Isolation, purification, and chemical characterization and proof of structure of the toxins, beginning with the well known ciguatera toxin widely found in reef fishes.

Biological and ecological investigation of the food chains producing marine toxins.

Pharmacological study of the effects of the toxins.

Development of a practical and analytical method for determining presence of toxins in fish and fish concentrates.

Part of the initial effort should be related to the ability of current processes for extracting FPC to eliminate any toxins which may be present in the raw fish.

I do not wish to leave the impression that the assurance of healthfulness of FPC—or even the healthfulness of fish supplies in general—is the sole justification for increased work in marine toxicology. We have high hopes that the specific toxins and other substances to be isolated from marine life will be pharmacologically useful and that some of them may eventually have regular clinical uses—as have other substances occurring in nature such as coumarin and ergot. These substances were first identified as poisons, but further observation on their mechanisms of action led to their exploitation for special purposes in clinical medicine, using small amounts. We can expect, similarly, that some of the toxins in marine organisms will be studied pharmacologically and may be found especially useful either in clinical medicine or biomedical research.

Since a number of marine toxins are considered to be concentrated in the food chain, or associated with the seasonal occurrence of certain types of protozoa or other plankton, we are now engaged in ascertaining how much work has been done on the cultivation of these organisms and in how additional research can be fostered if necessary. This is especially appropriate in relation to aqua-culture proposals. It may also afford us with relatively easy methods for harvesting toxins for further research. As I mentioned earlier, substances taken from marine organisms occupied considerable attention at the international symposium.

Mr. Chairman, this concludes my prepared statement. I shall be happy to respond to questions.

Dr. JACOBS. The Department of Health, Education, and Welfare has only one line item in the budget which directly relates to marine science and this regards shellfish sanitation. But we have a large number of other programs which do relate to it in various ways: We are involved in marine pharmacology and toxicology. The toxicology is princially in relation to poisons which occur in shellfish and in other types of marine life, reef fishes and so on, which we anticipate may eventually be used for fish protein concentrate. These toxins must be identified, and ways found to control them, to identify them in products, and in this manner make sure that the health of the people who are going to consume these products will be assured.

We also have programs in which marine organisms are used for biomedical research. There is a very diverse list of such organisms and a very diverse list of projects in which these organisms are used.

The development of knowledge about toxins and about other substances in marine organisms will undoubtedly prove valuable just as in the case of various forms of plant extracts from which we were able to develop drugs which became very useful in clinical medicine. We hope to do exploration in this area.

These are programs concerning health. Now, the Office of Education also has programs which are not specifically identified as marine science programs, but nevertheless do contribute in various ways to the development of oceanography. There are grants for the establishment of educational projects in marine science in the elementary and secondary schools. There are fellowships for the study of oceanography in graduate schools which supplement to some extent the National Science Foundation sea-grant college program.

This, in effect, is a summary of the high spots. You will find within the prepared text a broader description of our projects.

I will be happy to answer any questions.

Mr. LENNON. Do you recall approximately when the Food and Drug Administration approved this protein?

Dr. JACOBS. I think that was in February 1967.

Mr. LENNON. In that connection, I think it important to get from the Bureau of Commercial Fisheries the actions in sequence from the Bureau of Fisheries affecting the fish protein concentrate legislation and the administrative implementation of that act since they were officially advised of certification from the Secretary of Health, Education, and Welfare and the approval of the Food and Drug Administration as food.

(The information appears on p. 413.)

Mr. LENNON. With the establishment of the Marine Science Council under the actions we have referred to that became law June 21 of last year, there was an Ad Hoc Committee on Marine Toxicology and Pharmacology formed under the auspices of that Council. You were designated, I believe, as chairman of that committee?

Dr. JACOBS. Originally it was Dr. Milo D. Leavitt, Jr., whom I succeeded.

Mr. LENNON. You are presently in that capacity now?

Dr. JACOBS. Yes.

Mr. LENNON. Would you just briefly, sir, give us the substance of the responsibility and objective of this particular ad hoc committee?

Dr. JACOBS. Originally, Mr. Chairman, the committee was established to function as a subcommittee under the Food From the Sea Committee, which is chaired now by Mr. Waters.

We have been concerned with the problems involved in toxic materials in fish which might be present in mixed catches of fish processed for FPC. We are trying to find out how much work has gone on in this field; to stimulate work in identifying toxins which are found in reef fishes, in puffer fish and in other types of fish; and to find means to analyze fish protein concentrate to make sure no toxin is present and to make sure that the extraction procedures used in fish protein concentrate are adequate to remove any toxin which may be present. It is not that anybody is concerned about the presence of toxins in fish protein concentrate prepared from hakelike fishes caught in cold waters. But as Mr. Waters told you, they are anticipating the development of fish protein concentrate plants elsewhere, and the use of those plants might be prejudiced unless we knew the kinds of fish they were going to process which might contain some of these toxins.

It was an anticipatory move. I might say there is work going, on in Hawaii supported by the Public Health Service, various parts of the Public Health Service, on fish, toxins. More work is contemplated. We have a handle now on ciguatera toxin. At least it looks as if it is being purified enough so that we will be able to study its chemical and physical characteristics.

The Committee on Marine Pharmacology and Toxicology no longer has connection with the Food from the Sea Committee because its scope is now larger. It now includes pharmacology. The Committee is attempting in various ways to collate information on research projects in relation to pharmacologically active substances in a whole variety of marine organisms. It is trying to stimulate work on elucidating which particular marine organisms in the food chain are the origins of the toxins. The presence of a toxin in a fish may mean merely that the toxin is concentrated there after having been produced originally in a small planktonic organism and having been passed eventually to the fish through the various organisms who have grazed on what is called the sea grass and the predators which have eaten the grazers.

So, work on the cultivation of some of the small algae and protozoa in the sea becomes important.

There has been work very recently in our marine laboratory in Alabama which has resulted in the cultivation of a small dinoflagellate and the identification of a toxin in it which seems to be similar to the toxin in some shellfish. This kind of work will be very useful.

Toxins very frequently turn out in diminished concentrations to have pharmacological value when used. I can point out coumarin, which is hemorrhage producing poison if given in large amounts, but which is a very effective drug for the control of clotting, and is used, for instance, in the control of cardiovascular disease. Other toxins have become useful drugs by judicious use. We think we will find the same kind of thing to be true of many products derived from marine organisms.

Our committee is attempting now to gather all this type of information and to see how we can stimulate further work in this field.

I might say that it doesn't require a lot of stimulation because I can show you here a record of a conference held just this post summer, an international symposium on comparative pharmacology. I have gone through the proceedings of the symposium, and there are about a dozen papers which are devoted to pharmacologically active substances from the sea. There is a lot of interest because pharmacologists and other people realize the potential in the use of such organisms.

Mr. Lennon. Would it be fair to say that the creation of the National Council, or a Presidential Commission under the Marine Resources has made a contribution to the stimulus of you and the others in this field?

Dr. Jacobs. I am a little too new in my own job here to be able to make an objective statement about that.

Mr. Lennon. There was a committee formed by the direction of the National Council and you succeeded the gentleman who was originally named?

Dr. Jacobs. That is right. This would indicate activity, yes.

Mr. Lennon. We are delighted to hear that.

Dr. Jacobs. What I was about to say is that many of our programs have been going on for a long period of time. What we have done so far is to get a focal point of information, rather than to stimulate a large amount of new activity yet. We would like to stimulate new activity, but this must take into consideration to overall program within HEW and whatever constraints we get from the budget.

Mr. Pelly. Dr. Jacobs, I think it was the chairman of this committee in his interrogation of a witness some years ago who brought out the fact that HEW was putting a research installation near a facility of the Bureau of Commercial Fisheries, both of which were to look into diseases of shellfish, or the dangers resulting from such diseases. I wonder whether now, because of such possible duplication of effort, you are cooperating more closely with other agencies of Government so as to avoid incurring the additional expense arising from such actions?

Dr. JACOBS. Mr. Pelly, I am somewhat familiar with the programs not only of HEW, in regard to shellfish, but also of the Bureau of Commercial Fisheries. Just as a matter of scientific interest, I remember attending about 2 years ago a meeting of a local scientific society at which the people from the shellfish laboratory down at Easton spoke about their problems. These are not the same problems by any means as the ones which the Public Health Service is working on in its Marine Health Sciences Laboratories, or in its programs devoted to shellfish resources. The places where they are grown around this country——

Mr. PELLY. I am speaking of the respective responsibilities of each of the two agencies.

As I recall, we had some qualms as to why we should build two separate buildings under two separate appropriations when it seemed to us more economical and efficient to coordinate the programs.

Dr. JACOBS. I imagine that if they had been combined, you would have needed another building anyway, merely because of lack of space. I think the organizations work closely enough together from a scientific standpoint, but they have different problems.

Mr. PELLY. Well, as I recall at that time we couldn't get the representatives from the Bureau of Commercial Fisheries to admit that they didn't need a separate building. I won't prolong this, but I come back to my question, Are you working closely in collaboration with the other agencies?

Dr. JACOBS. There is no question about it. They are working on diseases of shellfish and we are working on diseases of human beings, which can be eliminated by keeping shellfish clean.

Mr. PELLY. Is there a tie-in between the two programs as far as shellfish are concerned?

Dr. JACOBS. Yes.

Mr. PELLY. I certainly want to convey to you the appreciation feeling I note from maritime and fisheries people in my district for the work of the Public Health Service.

You pointed out in your statement there are 400,000 persons eligible for direct medical treatment in Public Health Service facilities. This service is certainly of great benefit to them.

One other question I had concerns the meat inspection bill which came up recently and drew such wide interest and publicity. Is there a need, in your opinion, for similar inspection of fish and shellfish products?

Dr. JACOBS. As you know, the Food and Drug Administration exercises some surveillance over problems of smoked fish products and other types of fish products which are on the market.

The shellfish program is handled principally by the Public Health Service. There is an agreement between PHS and FDA on this.

Mr. PELLY. Then, as far as you know, the American people are not getting dirty fish the way they were, apparently, in some areas getting dirty meat?

Dr. Jacobs. Well, unfortunately, sometimes in smoked fish we have had the problem of clostridium botulinum poisoning because of the way the fish were packed, and the growth of this organism which produces a very potent toxin. It doesn't have to grow very much to produce a toxin which will kill you.

Mr. Pelly. Have there been any specific instances of this?

Dr. Jacobs. There were some a few years ago right here on the east coast and a few other places around the country.

Mr. Pelly. We also had a scare about cranberries.

Dr. Jacobs. The scare was due to some deaths in the case of clostridium botulinum, which is a little more serious than it was with the cranberries.

Mr. Pelly. It would be interesting to know whether there generally is a lax situation in the country today, or whether these examples of poisoning are isolated instances. Do you think the problem, if there be one, is properly under control?

Dr. Jacobs. I think we have the smoked fish situation under control now. To some extent it was due to methods of packaging the fish, but we also have to watch and see that plants are kept under very good sanitary conditions because we have also had clostridium in tuna packing.

Mr. Pelly. Who handles the inspection of imported fish and fish products?

Dr. Jacobs. Food and Drug would have responsibility for everything, except some raw shellfish. We have a shellfish certification program in the PHS in which we review, at the expense of the foreign government, the shellfish fisheries in Japan and Canada, and there are other countries trying to get in on this.

Mr. Pelly. I have one other question concerning pollution. The American people are anxious—and rightfully so—that Congress do something about both air and water pollution. I think that we have commenced to take some action in this area.

We recently passed out of the Merchant Marine and Fisheries Committee a bill to study our Nation's estuaries, including the pollution problem in those areas. Is your Department engaged in this pollution work in the area of fisheries?

Dr. Jacobs. We are engaged to some extent in assaying pollution. With salmonella, for instance——

Mr. Pelly. That is a name which you should change.

Dr. Jacobs. It is an unfortunate name because it has nothing to do with that delicious fish. It honors a great scientist named Salmon.

Mr. Pelly. I wish you would change that name.

Dr. Jacobs. It is too late to change it now. He is dead.

Mr. Pelly. We could change the name of the disease. You are making progress in that direction?

Dr. Jacobs. We are involved. As far as the study of the Chesapeake Bay, for instance, is concerned, the Department of Defense, as you know, is building a model. We are not directly concerned with it at the moment, but we are in liaison with them about it and we hope that we will be able to contribute as far as the pollution aspects are concerned.

Mr. Pelly. There certainly is a great need for control of pollution. I come from the Pacific Northwest, where we are fortunate enough to have sufficient water. Some people even want to steal it from us. We are trying to protect this precious asset and we are counting on the Federal Government, which has a responsibility in this area to help the local communities do what is necessary to keep our water pure, or correct it where it is polluted.

Dr. JACOBS. As a matter of fact, we do have programs being mounted in PHS directly in relation to water quality. To a great extent we have gotten the problem of infectious diseases in the water supply under control. There are other problems associated with water, like residual pesticides and other materials which get flushed into the streams.

Mr. PELLY. I know a lot of people would like to have the Public Health Service take over the problem of industrial water pollution. I think sometimes we have too many people working on the same thing and not getting enough done.

Where a State has its own pollution control agency, do you cooperate with it?

Dr. JACOBS. We cooperate with them; yes.

Mr. PELLY. Thank you very much.

Mr. LENNON. Doctor, I notice the newest of your specialized laboratory facilities is located in Gig Harbor in the State of Washington and is working closely with the University of Washington. Perhaps you need not comment on it now, but for the record I am sure Mr. Pelly would appreciate your putting in something on the great job they are doing.

(The information follows:)

NORTHWEST MARINE HEALTH SCIENCES LABORATORY

The Northwest Marine Health Sciences Laboratory, Gig Harbor, Washington, is located on Puget Sound approximately half way between Tacoma and Bremerton, in temporary facilities provided by the Health Department of the State of Washington. The activities in which it has recently been engaged include both microbiological studies relating to shellfish sanitation—work on viruses, on the significance of *Escherichia coli* as evidence of pollution and on the ecology of botulism in the marine environment—and work on problems of fresh water supply as affected by recreational activities, particularly in the water sheds supplying Tacoma and Seattle.

The PHS facilities at Gig Harbor have been used by several members of the faculty of the College of Fisheries of the University of Washington in Seattle. A productive working relationship exists between the two groups, and certain cooperative efforts have been undertaken, including a study of radiation pasteurization of shellfish.

The Public Health Service has acquired 17 acres of property at Manchester, Washington, formerly a part of a U.S. Navy net-tending station, and plans for the construction of a marine health science facility at this location are currently being developed. In fiscal year 1967 approximately $1 million was appropriated for planning and construction of the facility.

Negotiations have been undertaken by the Department of the Interior and the University of Washington looking toward the acquisition of the remainder of the property of which the PHS acreage forms a part. It is hoped that these efforts will eventually result in the creation of a complex of facilities capable of undertaking a broad range of research and development in marine biology and the public health aspects of marine food resources.

Mr. ROGERS. Your responsibility as the Deputy Assistant Secretary for Science runs you through all phases of this department, is that correct?

Dr. JACOBS. Yes; sir.

Mr. Rogers. Education as well as health?

Dr. Jacobs. I handle matters involving scientific substance, related to department policy questions, but I don't deal with education per se.

Mr. Rogers. Suppose you feel that a certain area of the science field is not being given proper support in the Department of Education?

Dr. Jacobs. I certainly have a means of communicating with the Office of Education to make any suggestion I wish to. We in our own group under Dr. Lee, the Assistant Secretary for Health and Scientific Affairs, are very concerned about health, manpower, and education in the health professions. So in that respect, we are directly concerned with education problems.

Mr. Rogers. How many graduate fellowships under title IV of the NDEA for teaching careers do you suppose are conducted by the Department or supported by the Department? Do you have any idea?

Dr. Jacobs. In regard to oceanography?

Mr. Rogers. No; all of them. The total amount.

Dr. Jacobs. I have a colleague here who may be able to speak to that. Dr. Lindquist.

Mr. Rogers. Check on it and then furnish us something for the record.

Dr. Lindquist. Under title IV of NDEA, which provides fellowships for college teaching, there are currently 49 fellowships being supported in marine science and technology out of a total of 15,000.

Mr. Rogers. 15,000 and only 49 of that number go to the marine sciences?

Dr. Lindquist. Yes; sir.

Mr. Rogers. This is the figure I want; thank you.

I hope you will take it back to the Department that we don't think that is much emphasis on education in the marine sciences field.

Dr. Lindquist. The fellowships are allocated to the universities by number according to the size and quality of the graduate school of the institution. It is a rather complicated process. Then the graduate deans and select committees at the institutions allocate the fellowships among the approved programs. So we do not control the allocation to approved programs except the recommendation could be made that this is a field that needs more support. The Office of Education does request that two-thirds of the fellowships be awarded to students in the humanities, social sciences, and education.

Mr. Rogers. Do they not make application to you as to what they want to do?

Dr. Lindquist. They make an application, sir, for the support of programs in different fields, and some are in oceanography. The graduate deans or the people who administer the programs at the universities can allocate these fellowships, the number allotted to them, in the fields they see fit among the approved programs.

Mr. Rogers. As I understand, do they not give you some idea how the distribution will be made?

Dr. Lindquist. No, sir; that is not the way it is done at the present time. When the program was first started, the institutions made a specific application, say, in the field of oceanography, and they asked for a specified number of fellowships. Now I am not sure how many the University of Miami, for example, gets, but say they get 60 fellowships. The dean there then can allocate these fellowships among the various approved departments as he sees fit.

Mr. Rogers. Florida Atlantic University now has a Department of Oceanography or Marine Science. How many fellowships do you suppose you have allocated them?

Dr. Lindquist. I am not sure that they have been approved for doctoral level work yet. I do not know that that university at present participates.

Mr. Rogers. Is this only doctoral work?

Dr. Lindquist. Yes, sir; under title IV NDEA fellowships. The program was set up primarily for preparing candidates for college teaching.

Mr. Rogers. How about Florida State University?

Dr. Lindquist. I think Florida State has a program in oceanography. I do not have the booklet with me at the present time to know whether Florida State has an approved program.

Dr. Jacobs. Mr. Chairman, I have the figure on Florida State University. There was one fellowship in marine sciences in the academic year 1967–68.

Mr. Rogers. What about Florida Atlantic?

Dr. Jacobs. Florida Atlantic is not on this list. I am familiar with Florida Atlantic because of a friend who teaches there. As I understand from communicating with him, the school is just getting going in some of these projects, and I imagine that later on they will be eligible for them, whereas they have not yet got themselves focused on all that they want to do.

Mr. Rogers. I should think some emphasis here, even though you do not pick out schools where they are doing it, would have a tendency to build up our competency in this area nationwide. Is this not true?

Dr. Jacobs. This is the aim of our contribution. As you know, we do not make the sole contribution here. For instance, NSF has the responsibility for the sea grant colleges.

I might mention the University of Miami is also well supported under title IV of NDEA. It has been supported with fellowships ever since 1960. They have six new fellowships in marine sciences this year plus five fellowships now in their second year. So, there is a fair amount of support going for some of these programs just in Florida.

Mr. Rogers. I would say 49 is a very insignificant number for the importance of this field in our national affairs. I would hope the Department would encourage perhaps some more work in this area. I did not realize that you do not have any direction at all in any of these programs. You just turn the money over to the schools for whatever they want to do with it. Is this the way I understand you are doing it?

Dr. Lindquist. Yes, sir; insofar as allocation of their allotted number of fellowships is concerned. The institutions apply for the programs that they would like supported, and the total number of fellowships they would like to receive for the year.

Mr. Rogers. Programs. What do you mean by "programs"? Do you mean marine science programs?

Dr. Lindquist. Marine science, chemistry, geology, history.

Mr. Rogers. Then they do designate which programs they want you to support?

Dr. LINDQUIST. That is right. They must have evidence that they have sufficient staff and facilities to give a doctoral degree at that institution in that field. Many institutions have doctoral programs that have not been approved by us because, in the judgment of the reviewing committees, they do not have the capability of really offering a substantial program, and hence they have not been approved.

Mr. ROGERS. The point I am aiming at is, do you have any way that you can help direct interest in a certain scientific field through your grants and fellowships?

Dr. LINDQUIST. We might encourage, but there is no direction or Federal control exercised. It is strictly the institutions proposing to us the fields they would like supported and, within their allocation of fellowships, they have freedom to allocate among the departments. It may be 1 year one department receives no fellowships. It is the way the institution sees fit to allocate their allotted number.

Mr. ROGERS. Actually they may come up with proposals that you approve but they never do it.

Dr. LINDQUIST. If there is evidence the field of oceanography was approved but never supported in 3 or 4 years, there would be some question about continuing the approval of that field.

Mr. ROGERS. I think this is a fairly strange way to operate.

Dr. JACOBS. Mr. Chairman, I would like to add a few things to Dr. Linquist's response to Mr. Rogers.

For one thing, if you counted the qualified scientists in all aspects of oceanography in the entire country just a few years ago, there were not enough to satisfy the Nation's needs. This was one basis for the sea grant college legislation.

I think we are doing another very important thing in the Office of Education. We are putting the seed down for the production of students who are going to be interested in becoming marine scientists. The Bureau of Elementary and Secondary Education has supported the establishment of a number of marine programs to interest elementary and secondary school youngsters in their developmental stages in marine sciences.

Mr. ROGERS. It appears to me you have only eight of those, according to your testimony; page 10.

Dr. JACOBS. Let me read these projects to you. Let me name the ones which are in existence now.

We have one in Beaufort, N.C., which provides for the development of a unique educational and cultural marine science center.

There is one in Poulsbo in the Kitsap School District of Washington, for a model marine science laboratory.

Mr. ROGERS. May I interrupt. If you would put those in the record for us, that would be fine.

(The requested information follows:)

MARINE SCIENCE EDUCATION PROJECTS SUPPORTED UNDER TITLE III OF THE ELEMENTARY AND SECONDARY EDUCATION ACT OF 1965 (PUBLIC LAW 89-10)

Title III provides grants for supplementary educational centers and services to assist in the development of elementary and secondary school programs to serve as models for regular school programs. Following is a list of the projects supported in marine science education:

1. SANTA ANA, CALIF.—ORANGE COUNTY SUPERINTENDENT OF SCHOOLS

Floating Marine Sciences Laboratory

Description: A marine science laboratory is providing activity centered experience for junior and senior high school students of the public and nonpublic schools in Orange County. The students are being offered an opportunity to expand their appreciation and understanding of science in a program integrating the science disciplines through the medium of oceanology.

Federal Funding: Fiscal year 1967—$99,634.

2. INVERNESS, FLA.—CITRUS COUNTY BOARD OF PUBLIC INSTRUCTION

Marine Science Station

Description: An environmental science center is being established to provide research and education in conservation, nature study, use of resources, meteorology and marine science using six different environments available in one location. The center is serving the general public, school systems in seven counties, local junior colleges, and various State agencies.

Federal Funding: Fiscal year 1967—$119,263.

3. KITTERY, MAINE—JOINT COMMITTEE ROBERT W. TRAIP ACADEMY

Regional Academic Marine Program

Description: Special facilities and programs are being planned for offering learning experiences in the marine sciences to the children and adults of the schools and community. Among the programs being considered are an introduction to marine plants and animals for elementary school pupils; advanced science courses, introduction to and career orientation in marine sciences, and opportunities for individual projects for secondary school students; summer institutes and marine science workshops for teachers; an instructional program for adults; visiting lecturers; marine aquarium facilities; and a traveling laboratory and museum. It is planned that this center will serve as an oceanographic museum and as a source of specimens of local flora and fauna which would be loaned to area educational institutions and State agencies. Number of persons to be served: 200,000 children and adults.

Federal Funding: Fiscal year 1966—$13,925.

4. FALMOUTH, MASS.—TOWN OF FALMOUTH SCHOOL COMMITTEE

Oceanographic Education Center

Description: Teaching units in oceanography are being incorporated into the junior high science curriculum. Marine scientists at the Woods Hole Oceanographic Institution are participating in an inservice training program for area teachers. An oceanographc education center is being established to exhibit and disseminate teaching aids, offer a question-answering service, and conduct adult education and summer classes.

Federal Funding: Fiscal year 1967—$95,715.

5. BEAUFORT, N.C.—CARTERET COUNTY BOARD OF EDUCATION

Development of a Unique Educational and Cultural Marine Science Center

Description: A center has been established for the study of marine ecology by students and adults in a coastal county. Marine science experts and educators are collaborating in interpreting marine environments through exhibits, coursework, and literature which are being adapted for the county schools and being made available to other school systems. The center is also being used as a demonstration center for other parts of the State and the large annual summer population.

Federal Funding: Fiscal year 1967—$74,206.

6. MANTEO, N.C.

Summer Marine Institute

Federal Funding: Fiscal year 1967—$25,000.

7. POULSBO, WASH.—NORTH KITSAP SCHOOL DISTRICT NO. 400

Planning a Model Marine Science Laboratory (FOR-SEA)

Description: A detailed feasibility study is being made to determine the effectiveness of the development and utilization of a model marine science laboratory for use in the kindergarten through grade 12 curriculums of public and nonpublic school systems throughout the county. Consultative planning with all agencies and specialists is determining the maximum effective use at all levels, including adult and area applications.

Federal Funding: Fiscal year 1967—$20,150.

8. SEATTLE, WASH.—SCHOOL DISTRICT NO. 1

Puget Sound Arts and Sciences Center

Description: An arts and sciences center has been established and is serving all public and private students in 32 school districts with professional performances and inservice educational programs for improved instruction in science and the humanities. Funds will be used to expand center activities in science and mathematics, including inservice education, demonstration and laboratory programs, astronomy, and oceanography. The total science and math component has been funded for $207,500 for the first year. Of this amount, $12,297 has been earmarked for the program in oceanography.

Federal Funding: Fiscal year 1967 for oceanography component—$12,297.

Mr. ROGERS. I see in your statement you say you have eight projects of marine science under title III of the Elementary and Secondary Education Act. How many grants for supplementary education centers and services under title III are actually made in all of the fields? How many would you estimate?

Dr. LINDQUIST. Since the program got underway in fiscal year 1966 under title III of the Elementary and Secondary Education Act, there have been something like 2,100 projects approved, of which eight have dealt with the area of marine science education.

Mr. ROGERS. This seems to be the pattern. Not enough emphasis is being placed on the field. If we are to encourage young people and educators to take an interest, I think we must do more. I am not sure you have the machinery to do that. Evidently, in your fellowships you have no way to give direction in areas where we may have shortages of personnel. We have just had testimony from the National Science Foundation that there is a great shortage in this area, and yet we seem not to be able to put emphasis on areas where, in the national welfare, we should be placing emphasis.

I think it might be helpful if you would submit to the committee suggestions as to how you could give proper emphasis. I am very much concerned about that. If you could give us some information on that, I think it would be well to give us a rundown on the specifics of how many of these programs you have overall, the specific projects for the marine sciences, if you could, to be helpful in the field. I am not being critical, but I think it has been true throughout our whole scientific community in Government that we have not yet grasped the importance of marine science to this country. We are trying to do this. We need to do it. If we can be helpful in putting some emphasis on it, this is what we want to do.

Dr. LINDQUIST. Mr. Drewry was a speaker at the recent Houston meeting on education for oceanography, and he emphasized in his speech the need to get out information of this type and stimulate interest in the elementary and secondary areas as well as at the collegiate level.

Mr. ROGERS. If you can give us facts on what we are doing now, I think it would be helpful to the committee in pointing up where we need added emphasis.

Mr. LENNON. It might be helpful if you would put in the record at what universities and colleges these 49 fellows are located. As I understand the National Defense Education Act, the emphasis in the first legislation was due to Sputnik. Sputnik, orbited by the Russians, stimulated the Congress to pass the National Defense Education Act. Each school is autonomous in its operation if it qualifies under the National Defense Education Act. If a person seeks a scholarship benefit under the National Defense Education Act, it is up to the school to make the determination of whether or not that scholarship or grant or award is made to that individual.

It does not necessarily follow that a school will make a scholarship grant to a student in the field of marine sciences or engineering or oceanology or oceanography unless they have a capability at their faculty level to teach in those fields. So, I think it would be helpful for you to put in the record the universities and colleges where these 49 fellows were actually in residence taking courses, because that would indicate to us the 49 universities and colleges that have a capability to teach marine sciences, and also marine engineering. I wonder if you could do that.

(The information requested follows:)

SUPPORT OF EDUCATION IN THE MARINE SCIENCES BY THE U.S. OFFICE OF EDUCATION

1. Graduate fellowships under title IV of the National Defense Education Act (Public Law 85-864), as amended.

The National Defense Graduate Fellowship Program provides fellowships, normally for a three-year period, to students with the baccalaurate degree who are interested in pursuiting an academic career of teaching in institutions of higher education and intend to enroll in a full-time course leading to the doctorate. The award of a fellowship carries a stipend of $2,000 for the first academic year of study increasing to $2,200 and $2,400 in the second and third years. There is an allowance of $400 for each dependent. In addition, an allowance of $2,500 per year is made to the institution attended by the Fellow to cover the cost of education.

The following table shows the institutions with approved graduate programs in the marine sciences and the number of Fellows supported for the current academic year.

Approved programs	Number of fellows supported, 1967–68		
	In 1st year of support	In 2d year of support	In 3d year of support
Johns Hopkins University	1	3	0
Texas A & M University	5	4	0
University of Rhode Island	2	3	0
University of Miami	6	5	0
University of California at San Diego	4	2	0
University of Michigan	0	1	0
Oregon State University	4	3	0
University of Washington	1	4	0
Florida State University	1	0	0
University of Virginia	0	0	0
Total	24	25	0

2. Marine science education projects under title III of the Elementary and Secondary Education Act of 1965 (Public Law 89–10)

See insert for page 751.

3. Special funds for training in occupations in the fishing industry under title I of the George-Barden Act (Public Law 79–586)

In fiscal year 1967, $360,000 of Federal funds were expended for this program allocated to the States by formula. There are a total of approximately 30 projects.

4. Grants and loans for the construction of undergraduate and graduate academic facilities under the Higher Education Facilities Act (Public Law 88–204)

The Act provides grants for the construction of undergraduate facilities (Title I), grants for the construction of graduate academic facilities (Title II), and loans for construction of academic facilities (Title III). Support for construction of facilities to be used at least in part for marine science education for fiscal years 1965, 1966, and 1967 follows.

Institution	Fiscal year	Type of facility	Grant/loan amount
Scripps College for Oceanography:			
HEFA I	1965	Library	$112,333
HEFA	1966	Addition to library	15,938
University of Rhode Island: HEFA II	1965	Oceanography library	125,000
University of Washington, Washington: HEFA I	1966	Oceanography teaching and Marine science library building.	456,190
New York University:			
HEFA I[1]	1966	Science and technology	995,530
HEFA III[1]	1966	do	4,000,000
Florida Institute of Technology:			
HEFA I[1]	1967	Science	292,726
HEFA III[1]	1967	do	382,000

[1] Only part of these facilities are to be utilized for oceanography curriculums and laboratories.

5. Support for educational research, surveys, and demonstrations under title IV of the Elementary and Secondary Education Act of 1965 (Public Law 89–10)

Thus far, one project has been funded (in fiscal year 1966 for $7,000) at the Valhalla Union Free School District No. 5, New York. This project entitled "A Formal Course in Oceanography at the Secondary School through Independent Study" will seek to determine the extent to which secondary school students can pursue independent study in oceanography when provided with course materials and advisors. Oceanography was selected for the project, among other reasons, because of widening interest and its absence from the secondary school curriculum.

6. Financial assistance in acquiring special equipment under title VI–A of the Higher Education Act of 1965 (Public Law 89–329)

This program asssists institutions of higher education in acquiring laboratory and other special equipment. In 1967 one project providing significant support for undergraduate instruction in oceanography was funded in the amount of $31,974 to Millersville State College, Pennsylvania. The award paid one-half the cost of acquisition of a catamaran and two mobile laboratory trailers, one for use primarily for geological oceanography and the other for use for biological and chemical oceanography.

7. Consultation

Staff of the Office of Education have written articles for education journals and provided consultative services to various State and local organizations and officials, including the Massachusetts Commissioner of Education in connection with the 1966 New England Conference on Ocean Science Education in Elementary and Secondary Schools.

Mr. LENNON. We had a very interesting colloquy yesterday with the witnesses from the National Science Foundation. We were quite surprised and pleased, although we have no documentation of it, to hear the witness respond that they were involved in the secondary school education, which would be the high school level, in the ocean sciences and programs.

They went on to say that every high school in America received a copy of their booklet that they send out annually, which rather shook me up, because I am sure if my high schools in North Carolina, many of which are right on the ocean, had received such information from the National Science Foundation, I would have had some inquiries from students, how can I get into program like this?

We do not question it, but it was a little surprising.

I think you raised a good point to request the witnesses to put in the record, too, Mr. Rogers, these secondary school model programs in the educational centers and their locations. I think you will find them necessarily related to either the Great Lakes or the Atlantic or the Pacific or the gulf coast, which is par for the course.

I think the real gist of this thing is to try to ascertain, through your insertion in the record, because, certainly, in order to qualify for a fellowship at the university or college they must have a faculty capability for teaching. That would give us some idea where the universities and colleges are so that we might suggest to young people who write to us, as they do:

> Where would you suggest that I apply for admission to college? I am interested in marine sciences, but also my family is not financially able to send me through, and I am hoping I can qualify for an NDEA scholarship.

That would be helpful to us. Thank you, sir.

Mr. ROGERS. Let us go to this question of inspection. Who has the responsibility to inspect fish packing plants?

Dr. JACOBS. FDA has authority under the Food, Drug, and Cosmetic Act to inspect fish processing plants. They do such inspections, and special ones, if they have any reason to believe that there is a problem with them.

Mr. ROGERS. I am not saying if they could do it. I am asking who does it. Do they actually have a program of doing this effectively?

Dr. JACOBS. Yes, they do, so far as I know, although they do not have the resources to do so as regularly as might be desirable. The Bureau of Commercial Fisheries also has an inspection service.

Mr. ROGERS. For health?

Dr. JACOBS. I believe so, but I am not familiar enough with it to tell you precisely what they do.

Mr. ROGERS. Will you submit a statement for the record on how this is done? Public Health does it for shellfish.

Dr. JACOBS. Yes.

Mr. ROGERS. Do they do it at the packing plant, or where is this done?

Dr. JACOBS. They survey the waters where the shellfish are produced. They also go into the plants. They do work on what they call the depuration of the shellfish.

Mr. ROGERS. Will you let us have that for the record, and give us some answer as to whether there is a program for inspection of fish packing plants, fish canning plants, and for fresh fish. Who inspects fresh fish?

Dr. JACOBS. I will submit that for the record.

Mr. ROGERS. Send me a copy of that to my office, please.

(The information requested follows:)

INSPECTION AND CONTROL OF FISH AND FISH PROCESSING FACILITIES BY THE DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Both the Food and Drug Administration and the Public Health Service are engaged in programs for controlling and assuring the healthfulness of fish and shellfish.

FOOD AND DRUG ADMINISTRATION

The Food and Drug Administration, under the statutory authorizations contained in the Food, Drug, and Cosmetic Act as amended, is empowered to inspect shipments of food intended for interstate commerce and imported foods and to seize or enjoin shipment of any "adulterated" product. A product is "adulterated" if, among other things, it contains bacteria, toxins, pesticides, and the like in potentially harmful quantity, or was prepared under unsanitary conditions. On a selective basis, FDA inspects both seafood processing and storage establishments and samples of seafood products in interstate commerce. Fish handling, packing, canning, and other processing plants are among those inspected. Fish samples analyzed include fresh, frozen, canned, and smoked fish, and other prepared fish products. FDA also conducts a voluntary compliance program to assist State and local authorities, as well as industry, to upgrade and maintain handling and processing activities. FDA has recently published proposed regulations covering good manufacturing practices for food manufacturing and processing establishments, and will supplement these with specific provisions for particular types of food, including seafood.

PUBLIC HEALTH SERVICE

The Water Supply and Sea Resources Program of the Public Health Service, by agreement with the Food and Drug Administration, exercises principal responsibility within DHEW for controlling the healthfulness of shellfish and shellfish products. The National Shellfish Sanitation Program, commenced in 1925, is a voluntary cooperative effort among the Public Health Service, State authorities, and the shellfish industry—involving, among other things, the development of guidelines for the growing, handling, and processing of shellfish. The Public Health Service conducts inspections of selected shellfish growing areas and shellfish processing and handling facilities, and otherwise evaluates the shellfish sanitation programs of the States. Actual continuing supervision of growing areas and processing plants and certification of shellfish shippers is a function of the State authorities. PHS acts by endorsing approved State control programs and by publishing a semi-monthly list of valid interstate shellfish shipper certificates issued by State authorities to shippers whom they have approved.

The control of shipments of shellfish from abroad is conducted by the Food and Drug Administration, with the exception of fresh and frozen products from Canada and Japan, both of whose programs have by agreement been made subject to review and approval by the Public Health Service, at the expense of those Governments.

The Public Health Service, Food and Drug Administration, and Department of the Interior have recently jointly promulgated recommendations for the processing of smoked fish products.

Mr. ROGERS. I see you do inspect the shellfish from some other countries. I believe you said three.

Dr. JACOBS. I am not sure whether the PHS program already extends to three countries or if it is still two.

Mr. ROGERS. But the others are not?

Dr. JACOBS. There are others which export shellfish to this country, but they are not covered by the PHS program.

Mr. ROGERS. What is the Department doing to let the public know of the benefits from marine life in the drug field? Are we doing anything on that?

Dr. JACOBS. To let the public know?

Mr. ROGERS. Yes, to let the American public know what is being done in this area.

Dr. JACOBS. We do have a public information system, but I do not know really whether or not any of the particular items that——

Mr. ROGERS. I would like a rundown on the benefits that we have already derived out of research in the health field. I want to get something out to the public on it. I think they ought to know it.

I notice you mention that already antiviral and antitumor properties have been demonstrated in shellfish extract.

Dr. JACOBS. That is right, sir. I would be glad to elaborate on that for you, too. These developments are not of such a level that the people who demonstrated them have yet been able to "sell" them to other investigators as especially useful things.

It is very interesting—in relation to some of these shellfish extracts—that there is a seasonal distribution in the times when these extracts have some antiviral or antitumor activity. This is why I am focusing on the idea of the marine plankton, the tiny organisms, because I think there are seasonal changes in the distribution of those organisms. If we are to find an antitumor extract, we probably will do it by identifying the right organisms which are around when the clams are harvested and are shown to have some minimal activity.

Mr. ROGERS. I would like a rundown on the activity in this area, the funding, and the number of people involved.

Dr. JACOBS. I would be happy to provide it.

Mr. ROGERS. I notice you mention two specific drugs that you say have been most helpful, coumarin——

Dr. JACOBS. That is an anticoagulant. It is from a bean. It is not from a marine form of life. I was merely giving the analogy that natural products with pharmacological activity usually reveal themselves to us first because of their poisoning effect, and that when we go to work on what is causing the toxicity, then we find that they are working one way or another, and we can put them to proper use medically. This was an analogy.

(The requested information follows:)

DRUGS FROM MARINE LIFE

Research on organisms occurring in the marine environment has disclosed many pharmacologically active substances, some of them in common use today and others only recently investigated. A growing body of literature has accompanied expanding activity in this field. For example, a Conference on Drugs from the Sea was held August 27-29, 1967, at the University of Rhode Island under the sponsorship of the Marine Biology Committee of the Marine Technology Society together with The College of Pharmacy of the University of Rhode Island and the Bio-Instrumentation Advisory Council of the American Institute of Biological Sciences. The conference program together with the abstracts of the papers delivered give some idea of current activity in marine pharmacology. As will be noted, a number of the papers given at the conference were prepared by investigators in the Public Health Service or with PHS financial support.

Accurate information is not available on the total manpower and funding currently being devoted to investigation and development of drugs from marine life. It can reasonably be estimated, however, that the equivalent of several man-years of time are now being spent annually in this area by professional investigators employed or financially supported by the Public Health Service alone.

The following information provides certain outstanding illustrations of drugs from the marine environment rather than a comprehensive view.

Long established uses

Among the best known marine-derived substances used to support man's physiological functions are (1) cod liver oil; (2) iodine; and (3) carragheen.

Drugs currently in use

1. PAM (pyridine aldoxide methiodide), a drug developed as a result of studies on the electric eel. PAM is useful as a potent antidote for pesticide poisoning and occasionally also as an antidote for drugs used in the treatment of myasthenia gravis. The organophosphates found in insecticides inhibit the natural enzyme cholinesterase which is necessary to remove the acetylcholine released when nerve impulses are transmitted at nerve endings. If the acetylcholine is not removed, a variety of serious symptoms occur which may ultimately lead to death. PAM reacts with the organophosphates to release the free cholinesterase, thus permitting it to react with the acetylcholine.

2. Cephalothin, an antibiotic obtained from a fungus found in the sea off the Coast of Sardinia. Cephalothin is a semi-synthetic derivative of cephalosporin C, an antibiotic similar to penicillin which is not attacked by pencillinase and is therefore active against certain bacteria no longer destroyed by penicillin.

3. Carrageenin, a drug extracted from Irish Moss for which an investigational new drug application has been filed but not yet approved; it has antisecretory action and is intended for use in the treatment of upper gastrointestinal complaints.

4. Certain drugs currently in use in Japan but not yet cleared for use in this country:

   (*a*) Kainic acid, a substance obtained from seaweed, useful as a vermifuge for treatment of roundworms, hookworms, and tapeworms.

   (*b*) Tetrodotoxin, a marine poison obtained from the puffer fish, used to relax muscular spasms and as a palliative in terminal cancer.

New developments

1. Shellfish extracts. Work by Dr. C. P. Li of the National Institutes of Health and Dr. Oscar Liu of the Northeast Marine Health Sciences Laboratory has demonstrated and described anti-viral and anti-leukemia activity in extracts of certain shellfish. Shellfish extracts proved effective against polio and influenza viruses in mice, although the degree of activity was low. A more potent extract was derived solely from the stomach and liver of the shellfish. Shellfish extracts also showed activity against tumors in hamsters and leukemia and carcinoma in mice.

2. The blue-green alga, *Lyngbya majuscula*, has been shown to have a variety of growth-inhibiting properties, anti-microbial, anti-viral, and fungicidal.

3. Studies of Antarctic penguins, the shrimp they consumed, and the algae consumed by the shrimp led to the isolation and identification of acrylic acid as a potential antibiotic.

Future prospects

A great many marine biotoxins have not yet been isolated and identified, and their properties characterized. Work within or supported by various segments of DHEW, as well as work in other Government agencies and in private institutions, will ultimately disclose valuable uses for some of these substances for therapy and medical research.

Mr. ROGERS. Also, would you let us have this for the record. I understand now they are talking about the possibility of operations at pressures, and so forth.

Dr. JACOBS. I think this is very important. I am glad you brought this up, Mr. Rogers.

With man in the sea and the anticipation that with further exploration of the Continental Shelf we will have more men in the sea, we do have to address ourselves to medical problems in regard to the hyperbaric situation.

There is something already going on in this area because people are also interested in it from the standpoint of man on the land in regard to cardiovascular disease. The Health Research Facilities Branch and the National Heart Institute of the National Institutes of Health have put money into special hyperbaric facilities. A fair amount is going on in this area.

Mr. ROGERS. It is very encouraging, as I understand it.

Dr. JACOBS. Yes.

Mr. ROGERS. Let us have a rundown on that, too, will you, for the record?

Dr. JACOBS. All right.

Mr. ROGERS. Thank you very much, Mr. Chairman.

(The requested information follows:)

SUPPORT FOR HYPERBARIC MEDICAL RESEARCH AND FOR CONSTRUCTION OF HYPERBARIC FACILITIES BY THE NATIONAL INSTITUTES OF HEALTH

The National Institutes of Health is either currently providing, or has recently provided, financial support for five projects involving medical research under hyperbaric pressures. It is anticipated that both the facilities and the supported research conducted in them will provide substantial assistance in dealing with the problems of man in the sea. The primary objective of the National Institutes of Health support of these projects, however, is to solve medical problems of man in his normal atmosphere and land environment, particularly to investigate the therapeutic value of hyperbaric oxygen.

1. DUKE UNIVERSITY

The National Heart Institute has for some years been providing funds by grant to Duke University to support a program of multidisciplinary investigation of hyperbaric oxygenation. Construction of new and enlarged hyperbaric environmental chamber facilities was initiated in 1965 and it is anticipated that active use of the chamber complex will occur early in 1968.

The environmental facility includes six compartments, each of which can be operated independently of the others. These are: a surgical sphere, with an eight atmosphere capability; a therapeutic chamber and personnel lock both with a capability from eight atmospheres positive to one Torr (equivalent to an altitude of more than 150,000 feet) negative; and a diagnostic chamber, personnel lock and water diving chamber, all capable of withstanding 30 atmospheres of pressure (equivalent to a diving descent of 1,000 feet in sea water).

Research in this new facility will include studiese (1) on the effect of oxygen under high pressure on cerebral blood flow, retinal blood flow, infection, and preservation and rejection of homotransplants; (2) of the physiology of liquid and dense gas respiration; and (3) on patients with stroke, myocardial infarction, shock, congenital heart disease, gas gangrene, and vascular occlusions.

The National Heart Institute has provided approximately $510,000 for the hyperbaric chamber, and through FY 1967 just less than $1 million to support the operation of the research program.

The hyperbaric chamber is located in a two-story wing of the large clinical research building for which the Division of Research Facilities and Resources supplied $1,036,984 through a Health Research Facilities grant.

2. UNIVERSITY OF PENNSYLVANIA SCHOOL OF MEDICINE

New environmental research laboratories, partially supported by grant from the National Heart Institute, are being developed at the University of Pennsylvania School of Medicine under the leadership of Dr. C. J. Lambertsen. These facilities, although not now completed, should become fully operational during 1968. The laboratories include a complete pressure unit with the capacity to simulate any known climate in the world and the range of environmental pressure, temperature, gaseous composition and humidity to be encountered in manned activities from sea level to 150,000 feet of altitude, and from the surface to a 1,600 foot depth in sea water. The new chamber system also includes a "wet" diving chamber which, when filled with water, will simulate the high pressure, wet, cold, buoyancy, and dense environment of the deep ocean. This will provide an intermediate step between conditions in the dry research chamber laboratories and those in the open sea.

Some of the research which will be carried out in these facilities includes studies of: the limits of oxygen concentration which cause pulmonary injury; the control of respiration; and the maximum pressures which can be tolerated by man and andimals. Other studiees will be included on the effects of high pressure oxygen on patients with peripheral vascular disease, the cerebral circulation, and the physiology of oxygen exchange in skeletal muscle.

The National Heart Institute has contributed about $475,000 toward this new facility, and through FY 1967 about $335,000 toward the support of the research program conducted with the use of existing facilities.

Dr. Lambertsen has also received support for design and construction of these facilities from a Health Research Facilities grant in the amount of $207,225.

3. HENNEPIN COUNTY GENERAL HOSPITAL, MINNESOTA

The facility at the Hennepin County General Hospital (formerly Minneapolis General Hospital) consists of a spherical operating room 19 feet in diameter to which are attached two cylindrical pressure chambers. Two attached mechanical rooms house the necessary ancillary components. Engineering was begun in July 1962, and the facility was completed in October 1966.

The types of research and treatment for which the hyperbaric chamber is being utilized include studies involving high pressure oxygen on adjunct circulatory systems, pulmonary embolism, renal artery occlusion, kidney transplantation, and changes in brainwaves under normal and high pressure oxygen in animals and investigation of the possible enhancement of anti-cancer agents and treatment of patients with gangrene. The National Heart Institute provided $337,525 for the chamber; a Health Research Facilities grant provided $72,707 for space.

4. CHILDREN'S HOSPITAL MEDICAL RESEARCH FOUNDATION, BOSTON, MASS.

The facility in Boston consists of a vertical 16 foot diameter cylindrical surgical chamber capable of developing five atmospheres absolute pressure, connected by locks to two horizontal cylinders 8 feet in diameter. One of these serves as a treatment chamber which can provide pressure ranging from 100 mm negative to five atmospheres positive, and the other is a recompression chamber and lock which can reach seven atmospheres in each component. These chambers, which replaced one 35 year old chamber, were completed in November 1965 and have been utilized for better clinical and experimental work since that date. Some of the kinds of studies which were in progress or projected at the time of completion of the new chambers were treatment of infants seriously ill with congenitally malformed hearts (some of whom received corrective surgery under high oxygen pressure), experimental treatment of newborn infants with respiratory distress syndrome, maintenance of viable transplant kidneys, the effects of high pressure oxygen on brain tissue, lung tissue and mesenteric circulation, and the management of diseases due to anaerobic organisms such as gangerene. Work projected for the future includes possible treatment for cerebral hypoxia due to heart failure and for carbon monoxide poisoning as well as studies of the effect of high pressure oxygen on tissue radiation. NHI supplied $339.334 which covered costs of the chamber and certain major items of equipment.

5. UNIVERSITY OF MARYLAND SCHOOL OF MEDICINE

A grant was awarded to the University of Maryland in 1964 for the construction of a surgical shock research facility. The total award was $787,500. Included in the grant were 50 percent matching funds for the construction of an oxygen high pressure chamber. The chamber constructed is essentially cylindrical in shape and divided into three sections. The surgical area has a diameter of 12 feet 6 inches, and the therapeutic and air-lock chambers have diameters of 10 feet 6 inches. The chamber is 68 feet 6 inches long, with a pressure capacity of 100 psi. It is air conditioned with controls permitting temperatures from 60 to 80 degrees Fahrenheit and relative humidity of 40 to 80 percent. Closed circuit TV is included. The total cost of the chamber was $298,750.

The fundamental theme of the proposed research is the study of shock at the cellular level in the human. The objectives are (*a*) elucidation of the biochemical and physiological alterations in shock, (*b*) development of therapeutic regimen, and (*c*) development of preventive measures. With regard to the chamber, it is proposed to evaluate oxygen under high pressure both as a therapeutic tool and with regard to its effectiveness on intermediary metabolism, the cardiorespiratory system, the systemic circulation, and kidney function.

CONCLUSION

The wide range of projects and the basic physiological data being accumulated from them can definitely be expected to yield information of importance to medical problems associated with the man in the sea program.

Mr. Lennon. Dr. Jacobs, we express our appreciation to you and your associates for your appearance this morning. We regret that we were delayed in the beginning of your testimony. Thank you very much.

We will conclude the hearings until next Monday, when we resume at 10 o'clock.

(Whereupon, at 12:40 p.m., the subcommittee adjourned, to reconvene Monday, December 11, 1967.)

NATIONAL MARINE SCIENCES PROGRAM

MONDAY, DECEMBER 11,1967

House of Representatives,
Subcommittee on Oceanography of the
Committee on Merchant Marine and Fisheries,
Washington, D.C.

The subcommittee met at 10 a.m., pursuant to notice in room 1334, Longworth House Office Building, Hon. Alton Lennon (chairman of the subcommittee) presiding.

Mr. Lennon. Gentlemen, the subcommittee will come to order.

We are delighted to have with us today as witnesses for the National Aeronautics and Space Administration, Dr. Robert C. Seamans, Jr., the Deputy Administrator, accompanied by Mr. Leonard Jaffe, Director of the Space Applications Program.

Gentlemen, I understand that you have a prepared statement and if it is your pleasure, Dr. Seamans and Mr. Jaffe, you may proceed with your statement and we will be delighted to hear from you.

STATEMENT OF DR. ROBERT C. SEAMANS, JR., DEPUTY ADMINISTRATOR, ACCOMPANIED BY LEONARD JAFFE, DIRECTOR, SPACE APPLICATIONS PROGRAMS, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Dr. Seamans. Thank you, Mr. Chairman.

Mr. Chairman and members of the subcommittee; it is indeed a pleasure and a privilege to appear before you at this time to discuss the activities of NASA in connection with the long-range national program in marine science.

NASA's activities in space oceanography are exploratory in nature to ascertain what, if any, potential benefits are to be gained in oceanography through the application of space techniques and equipment. Our current activities can be categorized in three major areas; first, investigation of the applicability of existing space technology, such as satellite data links, to problems of oceanography; second, studies of remote sensing of oceanographic phenomena including analysis of data obtainable from space missions not originally conceived for oceanographic purposes such as Gemini, Tiros and Nimbus pictures; and finally, when appropriate, development and test of remote sensors for viewing and discrimination of oceanographic phenomena.

Let me just say parenthetically that in addition we are conducting design studies of satellite systems that include oceanography as well as other things such as geology and agriculture, and we are looking at the commonality of the sensors between these disciplines.

These activities are directed toward the fulfillment of one of the objectives cited in the Space Act of 1958:

> The establishment of long-range studies of the potential benefits to be gained from, the opportunities for, and the problems involved in the utilization of aeronautical and space activities for peaceful and scientific purposes.

In 1964 an earth resources survey program was established within NASA with a portion of that program devoted to a study of the feasibility of conducting oceanographic exploration from aircraft and spacecraft. This is not a large effort in oceanography, but is one in which many of the potential users of oceanographic data have participated in the form of studies, tests or simply discussion. NASA sponsored a study at the Woods Hole Oceanographic Institution (WHOI) from August 24–28, 1964 under the chairman of Dr. Gifford C. Ewing of the WHOI to review the feasibility and to assess the interest of the oceanographic community in a space oceanography program. Since then, NASA has been working closely in a cooperative effort with interested elements of the Department of Interior, Commerce, and Navy principally the Navy Oceanographic Office. These agencies are assisting NASA through participation in conduct of aircraft experiments and assessment of the value of experiments as they may be applied in future satellites.

This cooperative effort is assisted by an ad hoc Spacecraft Oceanography Advisory Group consisting of members from Atomic Energy Commission, Naval Air Systems Command, Environmental Science Services Administration, Department of Health, Education, and Welfare, U.S. Geological Survey, National Academy of Engineering, National Academy of Science, National Science Foundation, Office of Naval Research, Smithsonian Institution, U.S. Army Coastal Engineering Research Center, U.S. Army Cold Regions Research and Engineering Laboratory, U.S. Coast Guard, Naval Research Laboratory, and Navy Space Systems Activity.

This group meets approximately once each quarter, or more frequently if required.

Spacecraft, of course, will not supplant surface, subsurface, and airborne research and monitoring systems; rather they will supplement them. The absolute accuracy, three dimensional capability, and selective resolution of these more conventional systems will continue to be necessary and must be utilized as a part of the overall system to their best advantage. However, earth-orbiting spacecraft have unique advantages for obtaining certain types of marine data as follows: Repetitive worldwide coverage, greater frequency of observation (once or twice daily for polar orbiting satellites and continuous for geostationary satellites), ability to observe remote areas at will, and an "all-weather" capability for certain parameters. Obscuring cloud cover on the the other hand limits the effectiveness and frequency of observation of some satellite sensors, particularly those that work in the visible region.

Space observation capability and other spacecraft technology have a dual role to play in supporting our national program in oceanography: Direct observation of the ocean surface, ocean-atmosphere interface, and ocean-ice floe, ocean-glacier, and ocean-estuary interfaces and data gathering assistance to conventional systems by providing for data collection, data, relay, and weather prediction (as a service to submarine and surface ships).

In the conventional oceanographic program we believe use of buoys, both tethered and free floating, by other agencies will certainly increase as a means to fill the expanding need for three-dimensional data. The development and application of new concepts such as deep-sea submersibles and man-in-the-sea will also play an important role in the data-collection process. An example of the potential value of spacecraft assistance as data collectors or data relays in support of such conventional research tools took place in the late summer of 1963. At that time, oceanographic data from the research ship *Geronimo*, which was near Nigeria, was relayed via the NASA communications satellite, Syncom II, to a computing center in Washington, D.C. Although this exercise had been intended as a demonstration, analysis of the data in Washington indicated that the shipboard measurements were grossly in error and a message to that effect was relayed almost immediately back to the *Geronimo* via Syncom II. Thus, the oceanographers were able to detect and repair an equipment defect and resurvey the area where the data were faulty before they had steamed away to their next research site.

A more recent example of data relay or collection by satellite is our use of the Applications Technology Satellite: ATS–I, which is in geostationary orbit over the Pacific Ocean. Using this satellite, rainfall and river height data are obtained experimentally from automated platforms and are twice daily relayed to the Weather Bureau's Office of Hydrology. This technique can be easily extended to be of assistance to the oceanographic community on a continuing basis.

NASA's role in bringing this technology to bear on measurements and data collection of terrestrial phenomena has not been extensively publicized, but is an aspect of our program which can have great impact on our Nation's expanding programs of oceanography. Of particular interest to marine scientists, such as buoy developers and users, is the interrogation, recording, and location system for terrestrial data collection. This system, IRLS for short, is being developed at NASA's Goddard Space Flight Center to demonstrate the feasibility of using a satellite to locate and determine the position of sensors, receive data from the sensors, record that data on board the spacecraft, and later relay the data to ground stations for collation and analysis. Possible terrestrial sensors re meteorological stations or buoys, oceanographic buoys, gages strapped to the earth for measuring strains leading to earthquakes, drifting balloons, ice islands, or any of a wide variety of data platforms located on the surface of the earth or in its atmosphere.

This first chart (SA66–15477) indicates schematically how this system could be used to collect oceanographic and other earth resources data. This, I think, is an excellent example of a system first conceived for specific discipline purposes—in this case meteorological—which has broad applicability for other uses, including oceanography. It is quite easy to conceive how such a system could begin to solve many of the problems hindering worldwide fixed or free buoy systems for the study of currents and ocean depth profile data. Such a system could greatly ease some of the data recording problems on which the National Academy of Sciences and others have made strong recommendations. In fact, with daily or twice daily interrogation of research buoys, the amount of data obtained could be greatly increased over present techniques and, furthermore, could be made available within a time period of minutes as opposed to the weeks or months associated with present buoy data collection techniques.

The location feature of the system also could conceivably permit broader application of free buoys by providing tracking and inventory on a near real time basis. Accurate analyses of free buoy drift over a long period of time would be a particularly useful tool for more accurately charting ocean currents.

The initial demonstration of this technique is planned for early 1968 using a polar orbiting meteorological satellite designated Nimbus B. Participation of the Woods Hole Oceanographic Institute with buoys in the North Atlantic, the Naval Oceanographic Office in the mid-Atlantic and the Bureau of Commercial Fisheries in the Northeast Pacific, will help to determine the true usefulness and cost effectiveness of such a system. These user agencies are buying their own platform equipment, I might point out.

We are just starting to experiment with a second system for locating remote sensors and gathering data from them. This next chart (SA67–2398) shows schematically how this system, called the omega position location experiment or OPLE for short, works. The remote sensor equipment located on a buoy, ship, airplane, or balloon, receives VLF signals from the Navy omega navigation stations and, on command, translates the signals up to VHF frequency and transmits them through ATS–III—that is our third Applications Technology Satellite—to the ATS ground station. Sensor readings are then fed over the same communication link to the ground station. After rather simple computation and data reduction at the ground stations, we have information as to the location of the remote platform and the readings of its sensors, whether ocean salinity, windspeed, temperature, or some other parameter. Preliminary experiments using engineering models of the sensor platform equipment and ATS–III have been conducted and have provided promising results. Of course, further studies and cost analyses of these new techniques will be required before one can State with assurance the most effective means of meeting the multidisciplinary purposes of ocean science and technology. This experiment is, however, typical of one of the many new developments which does hold promise for merger of ocean, air, and space technologies.

As indicated earlier, the other role that space activity can play in the Nation's oceanographic program is the direct observation of the world's oceans and their boundaries. A spectacular suggestion of the promise of this role is shown in the next chart (67–HC–723). This color picture taken by ATS–III, which is in geostationary orbit over the mouth of the Amazon River, shows the whole Atlantic Ocean from Greenland at the top to Antarctic on the bottom, and from the Americas on the left to Europe and Africa on the right. It also shows a large section of the Pacific Ocean to the west of South America. While this color camera was developed as a meteorological experiment, it also suggests the promise of such instruments as oceanographic tools. Although the ground resolution of this camera is only on the order of

2 miles, oceanographers are beginning to study these pictures to determine what, if any, use can be made of this kind of data in studying the ocean and its interfaces, interfaces with the land and with the air. For instance, preliminary study of one of these pictures indicates that differences may be apparent in the coloration of the ocean near the mouth of the Amazon River which may prove to be related to the effluent from the river. While the Gulf Stream is not apparent in this picture consideration is being given to the desirability of introducing inert dyes into this as well as other major ocean currents to study their short term as well as long term behavior from synchronous orbit. This, however, is still in the speculative stage, as our experience in synchronous orbit with imagery of moderate resolution, on the order of 1 or 2 miles, is less than a year old.

It is apparent to us that significantly greater resolution will be necessary to permit the optimum use of synchronous satellites to study the oceans and aid marine science. We have research and development efforts underway in this area, however, and our present capabilities as represented by this chart do provide excellent information on the weather patterns over the oceans and thus provide an opportunity to learn a great deal about the interchange of energy between the oceans and the atmosphere.

At the completion of my statement, Mr. Chairman, we do have a very short 3-minute film clip which shows the changing pattern which occurs in the course of 1 day as one views the hemisphere from above the South American Continent. This might be of interest to the committee.

Of perhaps more immediate practical benefit is our experience with imaging devices on our research and development weather satellites, Gemini spacecraft and research and development aircraft. Based on analyses of data received from these missions, we have summarized the potential areas for oceanographic observation by spacecraft on this next chart— SA67–15458.

I am sure all the items on this chart are familiar to you, Mr. Chairman, and members of the committee.

There are three distinct aspects of this activity. As the starting point, photographs and images returned by such satellites as Nimbus, Tiros, and Gemini are being analyzed to assess their oceanographic value. The second facet of the program is directed at preliminary development and evaluation of new remote sensors installed in aircraft. Finally, we are studying satellite systems and configuration specifically for possible earth resources survey missions. This is as I indicated at the start of my statement.

Thus far these studies have indicated that satellite photography and infrared imagery can provide wide coverage, great perspective, and rapid repetition of oceanographic phenomena measurements. While no other technique can produce such data, it must be recognized that, in general, optical techniques are limited to cloudless areas. Of course, repetitious clouds may indicate special ocean conditions which control these clouds. Major ocean currents, shoals, coastal and near shore features, are some of the apparent phenomena amenable to such clear weather sensing. For example, as shown in the chart—SA67–15431—data from the Nimbus high-resolution infrared radiometer have, on numerous occasions, indicated the western boundary of the Gulf Stream along the east coast of the continental United States on cloudless days. Gemini photographs, by their color gradations, have indicated turbid water and mixing boundaries near coastal regions and have yielded qualitative depth indications over shelf areas as indicated in the next chart—SA67–16937.

The broad band color film employed in the Gemini cameras lacked the advantages for scientific work of the multispectral photography possible in future missions. Multispectral photographic activity is presently underway on our aircraft missions and has indicated numerous potential space applications.

Let me say parenthetically that at the start of the Gemini program we asked several astronauts to investigate the possibility of taking photographs from the Gemini spacecraft. They developed, working with our engineers, preliminary designs of a camera which they found could be obtained commercially. These photographs were taken of targets of opportunity and consequently it is remarkable that so much has been achieved with them, but we believe much more can be achieved with a better understanding and use of multispectral photography.

The next chart—SA67–16672—shows the great dissimilarity of spectra from several different types of oils that are sometimes present on the surface of the oceans: sometimes in conjunction with the presence of schools of fish, at other times in conjunction with the marine disasters such as the recent sinking of the tanker *Torrey Canyon.* We have already discovered in our studies of agricultural crop signatures that such spectral dissimilarities can be used for computer identification of areas of various crops or pollutants. Thus it may be possible to develop automated systems for location of fruitful fishery regions and mapping of pollutant boundaries on a very near real-time basis. Aerial photographs have indicated a potential for satellite tracking of sea ice; ocean area cartography, measurement of sea state; and the detection of chlorophyll containing living matter. While these experiments using aircraft have been an indispensable element of our sensor development program for spacecraft, they also serve to improve our capabilities for operational oceanographic survey by aircraft. It is probable that ultimate operational systems of ocean surveys will depend on both automated spacecraft and instrumented high-flying aircraft, since each observing altitude had its own unique advantages.

Further improvements of infrared radiometry and imagery are being explored to permit sharper and more reliable determination of temperature gradients in the water which define boundaries, such as that of the Gulf Stream, as I mentioned earlier. Biologists consider this particular capability to be quite important because of the turbulent upwelling of nutrients along major current boundaries, which provides feeding for schools of fish and hence determines potentially profitable fishing grounds.

UASA's program of data collection by airborne remote-sensing instrumentation over special surface test sites has been underway for over 2 years. The next chart—SA68–15007—suggests its scope. A Convair and an Electra aircraft used in these tests have been equipped to obtain data using microwave radiometers and images, radar spectrometers, infrared radiometers and images, and multiband cameras.

This instrumentation is continually being expanded and evaluated against in situ measurements at these special test sites. The outcome of these tests and subequent evaluation will provide continuing input to our satellite systems design studies which are proceeding in parallel with the sensor activities.

One additional element of NASA's earth resources survey program that is as important for oceanography as for the other discipline elements is the matter of data management. We are developing a technological capability which could, if applied operationally, accumulate vast amounts of oceanographic data—data that are required to permit both an understanding of marine science and an exploitation of marine resources. We must, and we are, devoting considerable research effort directed toward developing the technology required to efficiently reduce, analyze, and utilize the large masses of data which may be produced by future satellites. The present accumulation of our limited research and development experiments signal the need for this facet of a full system.

Although I could cite other examples of possible satellite applications, the ultimate outcome of these activities cannot be forecast at this time, and I prefer not to become too speculative. Perhaps, it woud be safe to say, however, that these activities will at least produce new capabilities for aerial surveys of regions believed to be of interest to marine biologists or oceanographers prior to extensive in situ exploration. A typical example can be illustrated by a Gemini photograph of the Rongelap Atoll in the Pacific—SA68-15217—which, while not of mapping quality itself, indicated the inadequacy of existing charts of the area.

It is evident that space technology can provide an overview not obtainable by other means. It remains to be seen from the present and future experimental activities, how broadly applicable these technologies are in meeting the needs of future national and international oceanographic programs.

All agencies involved in oceanography participate in the activities of the National Council of Marine Resources and Engineering Development which provides the high-level policy coordination and program review in a manner similar to the National Aeronautics and Space Council in aeronautics and space. Furthermore, close management cooperation has been developed, as outlined earlier, to conduct specific studies and experiments. It must be understood that the equipment and techniques I have described are all in the study and research stage. Should these activities prove the technical and economic feasibility of an operational oceanographic satellite system, specific management relationships will be required to satisfy the development and operational needs. There is a precedent suitable for comparison in such circumstances; that is, the NASA/ESSA relationship in the operational meteorological satellite system.

There is an operational system at work today under the overall direction of ESSA: funded from their budget; routinely operated by ESSA personnel; and utilized for daily global weather prediction inputs by the Weather Bureau. The satellites, however, are procured by NASA contract with industry and with NASA personnel managing all production, tests, launching, and inflight checkout operations. In other words, on a reimbursable basis, NASA delivers Tiros Operational

Satellites to ESSA in orbit. This arrangement stems from the 10 research and development Tiros missions successfully conducted by NASA from 1960 through 1965. Close cooperation between NASA and ESSA and joint work on sensor development, experimentation, and data analysis were evident through this period and are still in effect today. This is a joint cooperative study and research effort, but in the development and operation of satellite systems we have found it necessary to delineate permanent and specific responsibilities for each agency. In addition, the resources and the budget for operational systems will be the responsibility of the user agency, as in the ESSA case I mentioned. This has found agreement with the Bureau of the Budget. This arrangement has worked in meteorology. Some variation of this type of management assignment may also be the best approach for any future operational satellite system suitable for oceanographic purposes.

One fact that is abundantly clear, however, is that the ever-growing national technology base must not remain compartmented. What we are learning in biology, medicine, instrumentation, communications, data processing, and many other fields must be shared. All agencies must strive to be broadly familiar with scientific progress and technological advances in many disciplines and must be willing to share their capabilities across organizational boundaries. We in NASA are committed to this objective.

Mr. Chairman, as I indicated while making the statement, we do have this short 3-minute film taken from synchronous altitudes, and if it is your pleasure, I will show it at this time.

Mr. LENNON. You may proceed.

Dr. SEAMANS. Before we start, I might mention that this satellite, which we call ATS, is located roughly over the coast of Brazil. It has the capability of taking color photographs about every 30 minutes, and these pictures are spliced together to show a sequence which lasts 1 day. The first ones spliced together will show the whole hemisphere and then we will show those taken over South America and then over Europe and the southern hemisphere.

(Thereupon, a 3-minute film was shown to the committee.)

Dr. SEAMANS. This is very new. This has only been available to any of us, including our experimenters, within the last several weeks.

Mr. LENNON. Thank you, Dr. Seamans and Mr. Jaffe.

I think you gentlemen know, perhaps, that four very distinguished members of the Science and Astronautics legislative authorization committee are likewise members of this particular Subcommittee on Oceanography. They are the gentleman from Ohio, Mr. Mosher; the gentleman from Washington, Mr. Pelly; the gentleman from Minnesota, Mr. Karth; and the gentleman from Virginia, Mr. Downing. So they sometimes attempt to advise us.

It might be interesting to note that as of October 1, 1967, there was prepared for the National Council of Marine Resources and Engineering Development, by two agencies, the National Aeronautics and Space Administration and the Naval Oceanographic Office, assisted by the Bureau of Commercial Fisheries of the Department of the Interior and the Environmental Sciences Services Administration of the Department of Commerce, a very interesting and beautiful pamphlet entitled U.S. Activities in Spacecraft Oceanography. It might be helpful to you gentlemen if you obtained a copy of that.

Now, the gentleman from Ohio, Mr. Mosher. Do you have any questions?

Mr. MOSHER. Mr. Chairman, it seems to me we just heard a very fascinating and useful statement. I will not ask any questions, but I ask the privilege of making this rather personal comment: Several of us have been working with Dr. Seamans over the years and we all regret that he is leaving the Government service. I think his leaving is a tremendous personal loss to those of us who work with him and a loss to the Government. I am sorry to see him go but I think we owe him a great debt of gratitude for his contribution in his very important leadership in the National Aeronautics and Space Administration.

Dr. SEAMANS. Thank you.

Mr. LENNON. The gentleman from Florida.

Mr. ROGERS. If I might be permitted to pass since there is a member from the other Legislative Committee present.

Mr. PELLY. Mr. Chairman, I want to second what Mr. Mosher said about the loss to our space effort as a result of the resignation of Dr. Seamans.

I am sure, though, that, although we ourselves will lose this contact, wherever Dr. Seamans is located others will benefit.

It has been a great privilege for all of us to work with Dr. Seamans.

I was particularly interested in the final statement and message you left with us—your insistence that agencies of the Government must work together. I think that is extremely important. It also is very timely since the future development of oceanography is now in the making.

I have a special personal interest because of the commercial fishery industry in my district and your statement concerning the possible exploration of the ocean for fishery resources. Again I know that the work that is done by NASA in this field will be helpful to the Bureau of Commercial Fisheries.

I am hopeful that developments will be made along this line because of the importance of the fisheries as a source of protein and food for exploding populations. For this reason your testimony was of special significance to me.

I want to thank you for a very fine statement. I hope the members of this and other committees will not lose contact with you, and that you will be back in the future. I hasten to add that we also will be here to continue this very interesting and exciting association we have had in the past.

Dr. SEAMANS. Let me say—as you know, I have a great interest in the space program but I also have a great interest in oceanography and some intimate understanding of it by virtue of sailing up and down the east coast from time to time.

I am delighted to see the way in which these efforts are coming together. I think more and more we will find that there is almost a continuant from the ocean to the air to space. I think I speak now more in scientific terms than technology, though the technology will have a lot in common as well.

Mr. PELLY. There was an article published in this month's issue of Fortune magazine entitled "Megalopolis Comes to the Northwest."

I noted in reading that article (the suggestion) that there might be a Government organization similar to NASA established—a "Wet NASA"—in the field of oceanography. I remember so well discussing this concept when some of us were working on the legislation which would decide how our efforts in the field should be directed. It ended up by charging the Commission on Marine Science, Engineering, and Resources with the responsibility of making recommendations in this area in its report.

It seemed to me that this was a matter of agencies working together and not one central agency. Dr. Wenk recently indicated that he held a similar view. I don't know what will come from the labors of the Commission, of course. However, I wondered whether you could comment with regard to your own feeling on the subject of which type of Government organization would best serve the interests of advancing our efforts in oceanography?

Dr. SEAMANS. Of course, my experience in this area, governmentally speaking, is rather limited. I have attended a good number of the Marine Council meetings. I have been impressed with what has been accomplished by the principals working in oceanography.

It becomes quite evident at the Council meetings that a great deal is now being accomplished.

I would say that Dr. Stratton and the Marine Commission are looking into this very issue at this time. I know Dr. Stratton from my previous years at MIT and I discussed this matter with him.

I prefer, though, not to anticipate what changes, if any, might be advisable. I really feel there is so much involved, that I am not familiar with in some of these areas, that I cannot give you a good answer.

Mr. PELLY. I think you have answered the question sufficiently and have made your point when you say all agencies should work together. I hope that whatever happens we will follow along that very line.

Thank you, Mr. Chairman.

Mr. KARTH. I choose not to embarrass Dr. Seamans this morning so just let me say, Mr. Chairman, that he is looked upon by technically capable people throughout the country as one of the most respected and most admired and experienced technical people in the country.

Dr. Seamans, I certainly share the opinion of my colleague from Ohio, Mr. Mosher, that when you leave NASA you will be recognized as having given perhaps as much as anyone in Government to Government and to the American people and more than most people have ever given. A great loss will be suffered as a result of your going.

I think no matter where Dr. Seamans goes, Mr. Chairman, whether in private industry, the academic community, or hopefully some other agency of Government, a great contribution will continue to be made and felt by all of us.

I was very impressed, Mr. Chairman, with the various slides and the 3-minute picture of the systems capability of an agency which really has no direct responsibility in this area. Even in spite of that they have exhibited a capability that I think we want, a capability that we need to do the kind of job that needs to be done so that oceanography probably will occupy its place in the sun that many of us see for it.

Just by virtue of the fact that through this systems management and systems analysis approach NASA has been able to show us as much or more about the ocean currents and where they are and how extensive they are than even those agencies who have had the primary responsibility for this important work. They have even shown us where large concentrations of fish take place and the potential migrations of these fish. Certainly many people on this subcommittee are interested in that.

Other than that, Mr. Chairman, I have no particular questions.

I think some years ago, perhaps 2 or more years ago, I suggested that one of the best things for oceanography might be an agency that I liken to what the gentleman mentioned a few moments ago, such as NASA. I am not sure whether a wet NASA should be part of dry NASA or not—or whatever you want to call it.

Nonetheless, here is an agency which has exhibited, I think, greater capability in seeking and getting answers to questions, to the unknowns, than any other agency of Government, and it might well be that NASA should play a very important part in whatever future oceanography has.

Dr. Seamans says he is not a meteorologist. Perhaps he is not experienced in some of these areas but in spite of that I have a feeling that Dr. Seamans knows as much about it as a good number of people who for any number of reasons have been recognized as experts.

With that in mind, Dr. Seamans, I would like to ask whether or not, in your opinion, this overall systems analysis approach, the systems capability approach, is not the kind of approach we need to get the answers to questions we seek in the whole field of oceanography.

Dr. SEAMANS. I think one very important element of exploration is the stage we are in now. We must evolve careful thinking through the possibility, I won't call them requirements, thinking of possible objectives for the ultimate operations system. To begin with, it is tenuous enough that it has to be thought of as an experimental program in order to get the data which then permits cost effective studies, and so on, to be worked out for the users.

I think one of the very important elements in having this successful is that the organizational setup must permit a relatively rapid transfer from ideas, scentific and technical ideas, over into experimental data to test the ideas.

As I said earlier, I prefer not to comment on what the organizational structure might be, overall, for oceanography because it is a very complex matter with many, many users, and so on, but I think the experimental work as applied to space—or I would imagine as applied to work using ships and submersibles—must permit the scientific and technical people involved to move quite rapidly from their ideas of phenomena or from ideas of how to do the job better over into a testing of their ideas.

I think we, in NASA, have not achieved the millenium in this regard but I think we have come a long way in providing a way of separating out conversation to hard facts of what you can and cannot do in given situations, and whether you really can come close to satisfying ultimate operational needs.

Mr. KARTH. One comment there, Mr. Chairman. I think it is appropriate that occasionally we do give credit where credit is due. I would hasten to add Dr. Seamans, that some of us have been critical at the lack of aggressiveness in certain programs and creativity in certain programs. But almost every single job NASA has done, every major project they have attempted, they have completed successfully. They are projects that never have been done before, and from original conception to completion on things that never have been done before by man this is an indication, I think, that NASA has done the very thing that you see as one of the things that must be done in oceanography—from the original conception of the idea to completion of the objective.

I do want to compliment you and your agency for having done this more so than any other agency in the government of this country and government of the world.

While we have had failures I think many of us who have been critical on occasions have been constructively critical and in that way tried to be helpful. At the same time we do recognize that your success ratio has been fantastic and unparalleled in the history of our Government.

Mr. Pelly. Would you agree with me that perhaps one of the most remarkable achievements in the development of NASA has been the gradual change of its relationship from military to civilian programs and its interface with military objectives? I don't think we would ever have had the Space Treaty for the Peaceful Use of Space had it not been for the existence of NASA. I think this is one of the really great achievements of the whole program.

Mr. Karth. I agree with you.

Dr. Seamans. I wonder if I might add a comment for clarification.

In the case of meteorology we made a decision, and this was very much on the late Dr. Dryden's mind, I know, and that is the extent to which we in NASA should get involved in meteorological research as such. We had to provide the tools for it. We followed a policy which tied right back to Dr. Dryden's views that we would not try to build up in NASA a comprehensive capability for the scientific effort involved in meteorological study but this should be the responsibility of the Weather Bureau in the Department of Commerce.

We had to have enough people in NASA familiar with this field so that we could communicate back and forth, but we were not going to try to fold into the NASA organization a total meteorological competence.

The same is true with regard to oceanography. It would be a mistake for NASA to try to develop complete expertise in all of the many sciences which relate to oceanographic work. Rather we should rely on those who already have this competence for the scientific work and we should make the tools available, as they make sense to make them available, in aircraft and in space, and to just have enough competence in NASA that we can be intelligent in the way we carry out our expermiental work for the user.

Mr. Karth. Thank you, Mr. Chairman.

Mr. Edwards. Dr. Seamans, you ought to get a copy of the record and retain the words that have been said about you today. This committee usually doesn't say such nice things about every witness that comes before it.

I was extremely interested in your comments concerning the need for coordination and the need to work together and the need to exchange information and cross departmental boundaries.

Do you find that presently we have the coordination which you think is necessary?

Dr. SEAMANS. I don't want to imply from what I have said that people are holding back, one from another, but quite the contrary. We have to work harder at improving the coordination because it is a difficult thing to do. It takes effort to spend the time to understand the other person's program and his problems and it takes very good data transmission back and forth to make this possible.

Mr. EDWARDS. You feel there is still room for improvement in that area?

Dr. SEAMANS. No matter what happens there will always be room for improvement in an area such as this.

Here in oceanography obviously we are neophytes and there are many others who are now getting involved who are learning. I think there is a great deal to be done to improve coordination and exchange of data. I think this is generally recognized. I think the Vice President is performing an extremely useful role with the Marine Council in this regard.

Mr. EDWARDS. The Marine Council is doing a good job, then, in your opinion, in drawing together the agencies and projects and data necessary to fulfill this mission?

Dr. SEAMANS. I think it is doing an excellent job. I am very pleased to see that the Marine Council, for example, is willing to delegate certain of the functions it might take on. At the last meeting of the Marine Council there was a question of what agency would coordinate the work which relates to use of spacecraft with some thought that possibly this might be done by the staff of the Marine Council.

When they found we were ready to take this on they were happy to have us take on this responsibility, and that is the way it will be done.

Mr. EDWARDS. From a mechanical standpoint and referring to page 1 of your statement you talk there about NASA's activities in space and oceanography.

Strictly from a mechanical standpoint how did NASA assume this particular activity or responsibility? Were they delegated to you by the Marine Council or were these projects that you felt could be carried out and you therefore said to the Marine Council "These are projects we think we can do."?

Dr. SEAMANS. First, we were doing the work. We were working on a variety of data links and communications schemes using satellites at the start, not really considering oceanography as one of the uses. Mr. Jaffe and others, in the backs of their minds, were thinking of it.

The same way with the Gemini program. We decided to take photographs from the Gemini as a means for gathering important information. To begin with this was looked at as a general capability. Then as we got into the program and into both of these areas we found at the working levels between agencies there was interest in what we were obtaining, and consequently we did somewhat more. We took some special photographs from Gemini, for example, upon recommendation of people concerned with oceanography, and over a period of time we developed studies that NASA actually funded.

We have funded, working through the Navy primarily, and they in turn working as a coordinator for oceanography, about $1 million worth of effort.

We have in our budget in fiscal year 1968 plans for transferring about $1.6 million for oceanographic purposes. This is broken down into specific studies and these studies will be managed by agencies other than NASA. The results of the studies tie back to those things which we in NASA might do either with data links or imaging devices or radiometers that will be applicable to oceanography.

All this was in being at the time but still quite embryonic at the time that the Marine Council was put into the law.

Since then at the meetings of the Marine Council we have reported to the total Council on what we are doing to see whether there are suggestions for augmenting it or improving it. I think at the next to the last meeting Mr. Jaffe gave a 20 to 25 minute presentation to all members of the Council, including the Chairman, as to what was going on.

Mr. Edwards. On page 2 you refer to the ad hoc spacecraft oceanography advisory group, consisting of certain members.

What is the relationship of that group to the Marine Council?

Dr. Seamans. This is the group which was chaired by a member of the Navy. It is to advise us on our program. We have a breakout of our plans for 1968 and some individual studies. I can submit this to the committee if it is the pleasure of the chairman.

It is to go over these kinds of things in detail that we have this group. There is not time for the Marine Council to go into great detail on each individual study that may amount to $40,000 to $50,000.

Mr. Edwards. There is no duplication between the ad hoc group and the Marine Council?

Dr. Seamans. No. What we do with the ad hoc group is known to the staff of the Marine Council.

Mr. Edwards. Thank you, Mr. Chairman.

Mr. Rogers. I think every one is familiar with your contribution and regrets your decision to leave NASA. I share this feeling.

What is the total budget figure that NASA devotes to oceanographic work? I realize there is an interconnection with many things you do, but what would you say an overall figure is?

Dr. Seamans. The figure I just mentioned is the total figure directly related to oceanography and to no other discipline. It is planned in 1968 that that will be $1.61 million.

Mr. Rogers. Out of a total budget of what?

Dr. Seamans. This comes out of a total NASA budget of $4.58 billion.

Mr. Rogers. Do you think this is a proper ratio? In other words, even in NASA are we giving proper emphasis to oceanography?

Before you answer that, one of the concerns of the committee has been that many of our agencies have not yet realized the significance of oceanography and the economic impact it can have on this Nation. I think we have been slow to realize this. We are beginning to realize this now and I wonder whether you feel this is a proper perspective, both from your point of view and the point of view of NASA.

Dr. SEAMANS. I am sure we all agree that if this were the total extent of oceanographic research in this country this would be way out of balance. To view balances one must look at the total program for oceanographic research as compared to space research.

I think this is an appropriate amount for what we call supporting research. Technological investigations, for NASA at this time. It is a question at this time of studying possibilities. It may be that at some future time, as I mention in my statement, we should embark on special sensor development and ultimately a spacecraft development for this purpose.

I don't think it is clear at this time, and it will not be until these studies are complete, what developments are appropriate, and in this context we are considering sensor development that might have application not only to oceanography but to hydrology and other resources.

Mr. ROGERS. As to weather, do you have a separate category for your research work on weather, and air-sea interaction, or is this included in the $1.6 million?

Dr. SEAMANS. I would like to ask Mr. Jaffe to respond to that.

Mr. JAFFE. That specific subject—research on weather and air-sea interaction—is funded by the Department of Commerce. This specific $1.6 million is related to those research tasks and efforts which are designed to explore how oceanography might benefit from space technology so it is not an all-encompassing oceanographic research effort but it is specifically related to an exploration of how we might use space.

Mr. ROGERS. You are saying you have no specific program on interaction at all?

Mr. JAFFE. There is a program coordinated with ESSA. The portion of the program NASA is responsible for is the determination of the kinds of instruments that might be used in space to shed light on air-sea interaction. Some instruments we are exploring today in the earth resources survey program, and some of these instruments of oceanographic community is working with apply to this problem of air-sea interaction.

Specifically we have recently been able to relate measurement of sea state (wave height) with the lower atmospheric winds. This will be tremendously important to this whole problem of weather prediction and sea-air interaction.

However, the research relating to weather prediction and to other predictions as it applies to operational processes, the part we hold ESSA responsible for, there we look to them.

Mr. ROGERS. Do you have a program already set up involving buoys which are now transmitting to satellites? Is this an ongoing program or is it research?

Mr. JAFFE. Research. There are several buoys which the Navy is instrumenting, which ESSA is instrumenting, and these are being used experimentally to determine the worth of this kind of system. It is not operational.

Mr. ROGERS. It is pretty well admitted that this is a very constructive program, is it not?

Dr. SEAMANS. When we talk about a research or experimental program I want to make it clear that there will be buoys available and managed by the groups I mentioned in my statement in time for the Nimbus launching, which will be the end of this coming winter, and we will through the Nimbus spacecraft receive signals from these buoys with whatever type of oceanographic data that the experimenters want. This data will be stored in the spacecraft and when it comes over at an appropriate place it will be fed down to the ground.

On an experimental basis we are trying out a new idea, you might say. This is not just in the dream stage. We actually have the hardware to permit this experiment to be carried out.

Mr. ROGERS. It seems to me we are not putting enough emphasis on oceanography in many of the various agency budgets.

Are there any restrictions on our placing craft in space because of the treaty?

Dr. SEAMANS. Not for scientific experimental purposes.

Mr. ROGERS. As long as it is scientific and experimental we can do whatever we want. Is there any prohibition?

Dr. SEAMANS. My understanding is that the prohibition is upon placing nuclear armaments into space, aggressive military types of systems. There has been no prohibition on any of the activities that we in NASA have underway.

Mr. ROGERS. In other words, whatever our capability is. Is that correct? In other words, if we can gain economic benefit we can do it as long as it is not associated with the war effort, I presume?

Dr. SEAMANS. Yes. There is no restriction on the nonmilitary use of space as a result of the treaty.

Mr. ROGERS. So we can do whatever we want.

Dr. SEAMANS. Whatever we feel is appropriate for scientific, technical, or operational purposes.

Mr. ROGERS. Do you think that should pretty well apply to the ocean?

Dr. SEAMANS. You mean oceangoing vessels?

Mr. ROGERS. I was thinking of underwater craft and the use of the ocean.

Dr. SEAMANS. Surface or submersibles?

Mr. ROGERS. Even the ocean bottom.

Dr. SEAMANS. Again we are getting into an area that I have little familiarity with. I would prefer you ask somebody more expert than I.

Mr. ROGERS. Thank you very much, Doctor.

Mr. LENNON. This is an interesting colloquy which has been going on with respect to the participation of NASA in the fields of oceanography and the marine sciences. Some of these things we perhaps did not know about except for those members who are also members of the distinguished committee on space.

I note your statement that for more than 4 years NASA has to some degree been involved in activities concerning collection of data and making data relays in support of this project, and even as early as 1963 and 1964 agreements and contracts were entered into.

I am sure the distinguished members of the other committee knew that, but I was not privileged to have that information. I think it is rather tragic that we did not seize the opportunity to have you folks come to tell us about this earlier because in the minds of the American people the image of space is fantastic, emotional, and gratifying.

Right now you find a little feeling throughout the country that perhaps we ought to take another look at this space program because of its cost on a national level because of some of the other problems we are involved in. So many people relate space primarily to the national defense posture to justify their support of it.

In the light of the budgetary problems and the fact we have had an unbalanced budget for only 6 years out of the last 38, I was privileged to ask some questions of DOD here about 2 weeks ago to determine as best I could NASA's contribution to our overall national defense posture and its relation to it.

I was a little upset by the testimony given by the representatives of DOD with regard to the contribution of NASA to our so-called program as it relates to national defense.

I think it is well that we have this discussion this morning, particularly what you have said, Mr. Rogers, that it is a rather small part of their total annual budget. If you are making this contribution to the development of oceanography and have been doing that since back in 1963, I am interested. The program of IRLS is spelled out in detail on page 22 of this splendid booklet you put out, and this interests me, too.

I understand that this system will be scheduled for test flight some time early next year. You hope it will eventually be capable of fixing positions and recording data twice a day. You showed from the slides how this instrument would be in touch with buoys and vessels throughout a great part of the ocean's surface.

Coming back to the establishment of the National Council on Marine Resources and Engineering Development, that act was signed into law on June 21 of last year. The National Council had its meeting on August 17 of last year.

Even 3 years before the National Council came into being NASA had been engaged in connection with the oceanographic school of the Navy and a number of other interested Government-financed agencies in the field of oceanography.

Is that a fair statement?

Dr. SEAMANS. Yes; it is, Mr. Chairman.

I would like to amplify the point so there is no misunderstanding here. So one does not think we are moving into oceanography in a manner that migh not be desirable——

Mr. LENNON. I am not making that point. The Navy could see the potential of the satellite relays. I am sure there was a mutual situation, and they came to you folks. Frankly I didn't know about it. I am delighted to hear this. This is more justification for support of the space program.

This is even though I was disappointed from what I heard from DOD with regard to its contribution to national defense.

Getting down to the establishment of the National Council, which I indicated had its first meeting in August of last year, we all know that the administrator of NASA is one of the observers named in the act.

Has that brought together at a coordinating level an even better working relationship with NASA and the other agencies of the Federal Government and those so-called private institutions which are financed primarily through Government grants?

Dr. SEAMANS. I think it has done an excellent job.

Mr. LENNON. In other words, to make a long story short, you would not have had this information for dissemination otherwise. This was done for the National Council on Marine Resources by you, the Naval Oceanographic Office, the Bureau of National Fisheries, and the Department of Commerce.

I know this is for public dissemination, so they should get a new insight as to NASA's contribution to the fields of the marine sciences they have not had before. I refer now to the general public.

Dr. SEAMANS. Right.

Mr. LENNON. I am delighted with that.

I would just say that if this committee had known that you were involved in this to the extent that you are, we might have pushed a little harder for a few more dollars so that a little more of this money could have been allocated in this direction. We are looking over our shoulders in retrospect. I wish you had been involved in it more so that you could have perhaps done an even better job.

I wonder if counsel has questions.

Mr. KARTH. Will the Chairman yield?

Mr. LENNON. Yes, because you and Mr. Pelly have been close to this.

Mr. KARTH. In all fairness to NASA it must be said——

Mr. LENNON. I am not being critical at all.

Mr. KARTH. I understand.

Mr. LENNON. I am delighted to know this is going on.

Mr. KARTH. I think one of the reasons this probably has not been brought to the attention of the committee as it otherwise would have been, is because the programs that the distinguished chairman refers to, including the Tiros, ATS, the Syncom, Nimbus, and the Gemini program, whatever applicability these programs have to oceanography and whatever breakthroughs they might have made, whatever contributions they lend to this new field of technology, have been made, Mr. Chairman, inadvertently, as spinoffs of programs which have other objectives as their primary purpose.

I would hasten to add that if this agency were requested by a legislative committee or by someone within Government to lend its profound systems capability to answering specifically many of the questions that we have relating to oceanology, that they would indeed perform a very valuable service and indeed, I think, answer the questions in a very hasty and thorough manner.

So, Mr. Chairman, all I want to say is that I think what this booklet implies or says is that even though NASA has not been involved by invitation or otherwise to directly participate in oceanography or oceanology and marine sciences, that spinoff benefits from other programs have been so applicable that they tell a very meaningful story. I am only hopeful that some place along the line, Dr. Seamans, this capability that we have in NASA can be more directly put to the test of answering the questions and solving the problems that we have in the marine sciences and oceanography.

Would you say that I have fairly stated the case as it applies to the information that you have given to us today?

Dr. SEAMANS. Yes. I think that is an excellent summary. I might say, Mr. Chairman, that Mr. Karth is chairman of the subcommittee on the House Committee on Science and Astronautics that relates to space science and applications.

We have, as you well know, a very detailed budget and budget review with the Congress and we have one line item in our research and development program that relates to applications. The work that we have done in oceanography comes under this line item and it is the responsibility of Mr. Karth to review that program.

The preponderance of the work has been related to meteorology and communications. But we do have some small amount of supporting research funds in that line item to see how this technology can be applied to other areas, as a spinoff. That we have attempted to do.

Mr. LENNON. We will make him our expert witness from now on.

Thank you very much.

Counsel, do you have questions?

Mr. DREWRY. Along that line, what is the total of that line item for 1968?

Dr. SEAMANS. $104 million was the request, and I think we are budgeting in the order of $99 million.

Mr. DREWRY. $1,600,000 of that is for oceanography?

Dr. SEAMANS. Yes. We also have funds that we are transferring to Agriculture to see how it could benefit agriculture. It gets into hydrology and weather forecasting and other areas.

Approximately $6 million is transferred to other agencies to look into these possible applications. In addition, we are funding this aircraft program that I have described. We have to finance the flying of the airplanes, the procurement of the sensors.

The other agencies, including those involved in oceanography, are responsible for the in situ measurement on the particular sites that we fly over. Then we provide them the data for purposes of correlation.

Mr. DREWRY. You mentioned meteorology and communications sharing in this same line item. How much is allocated to meteorology and how much to comunication?

Dr. SEAMANS. I would have to give you a breakout of that, but a large percentage of the efforts is in those areas.

(The information follows:)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

RESEARCH AND DEVELOPMENT (NOA)—FISCAL YEAR 1968 BUDGET ACTIONS BY PROJECT

[In thousands of dollars]

Program and project	NASA budget submission	Authorization	Appropriation	Operating plan
OSSA:				
Physics and astronomy	147,500	145,500	130,000	141,550
SRT/advanced studies	19,900			23,950
Solar observatories	11,900			12,145
Astronomical observatories	40,600			38,100
Geophysical observatories	20,000			20,158
Pioneer	7,500			7,000
Sounding rockets	22,000			20,000
Sunblazer	2,000			
Data analysis	2,000			2,892
Explorers	21,600			17,305
Atmosphere	(294)			(382)
Owl	(700)			(1,200)
IMP	(8,152)			(5,464)
Air density/Injun	(800)			(1,350)
United Kingdom	(28)			(9)
ESRO	(94)			(69)
ISIS	(1,748)			(1,514)
Beacon	(135)			(----------)
German	(192)			(241)
San Marco	(239)			(543)
Small scientific satellites	(2,380)			(1,000)
Radio astronomy	(3,338)			(2,780)
X-ray (small astronomical satellites)	(2,500)			(2,753)
Pilgrim	(1,000)			(----------)
Lunar and planetary	142,000	131,900	125,000	143,400
SRT/advanced studies	20,900			31,800
Surveyor	42,200			35,580
Lunar Orbiter	10,000			9,500
Mariner	68,900			65,520
Voyager (completion of phase B study)				1,000
Voyager	71,500	42,000		
Launch vehicle procurement	165,100	157,700	145,000	141,900
SRT/advanced studies	4,000			4,000
Scout	16,800			10,200
Delta	32,600			30,300
Agena	24,700			14,400
Centaur	87,000			83,000
Bioscience	44,300	41,800	40,009	41,800
SRT	14,300			11,800
Biosatellite	30,000			30,000
Space applications	104,200	99,500	88,000	99,500
SRT (supporting research and technology)	16,600			18,800
Tiros/TOS improvements (meteorology)	7,500			9,100
Nimbus A–D (meteorology)	29,500			32,700
Nimbus E–F (meteorology)	5,000			1,000
Meteorological soundings	3,000			3,000
French satellite number 2	100			100
ATS A–E (communications and other)	19,800			21,500
ATS F–G (Communications and other)	15,700			4,100
Geodetic satellites	4,700			3,400
Voice broadcast satellite	2,300			
Earth resources survey				5,800
Total	674,600	618,400	528,000	568,150

Mr. DREWRY. The thing that is of interest to me, when you made reference to the ad hoc group which I think adds up to about 15 agencies or subagencies, is the means by which NASA finds out what the users want in the way of oceanographic information by means of satellite or spacecraft.

Dr. SEAMANS. That is the way of formalizing it. Of course, it is a method of communication. It is also necessary to have those responsible for actually carrying out our research and development work, say, at or near Goddard Spaceflight Center, in intimate and almost daily contact with the oceanographic community. I guess in the particular case of oceanography it may even be more appropriate at our Manned Spacecraft Center at Houston because they are operating the two aircraft that I mentioned. It must get right down to a day-to-day kind of communication back and forth in order to carry out these programs.

Mr. DREWRY. It is probably too early to ask you about what your funding for 1969 will be.

Dr. SEAMANS. It is too early, obviously, in that the budget has not been approved as yet, but we anticipate it will be of the same order as 1968.

Mr. DREWRY. As I understand you and Mr. Karth, the development of your activities in oceanography has been sort of a spinoff nature. You have done certain things, you have very obviously said "Oh boy, here is something that can be used in oceanography." Some communication with user agencies would indicate that they say "Sure, that looks pretty good. Do it some more." But up until now I judge from the tone of your statement that you still feel that you are in pretty much of an exploratory stage or experimental stage. You used the term in connection with the development and test of remote sensors as something you will get to "when appropriate." I wonder if it isn't appropriate right now, now that you have found so much can be done, that there be an active coordination among the agencies, either through the Council or otherwise? Do you have anything or is there anything such as, say, a 5-year program of areas which should be worked on and developed? Or is it more casual?

Dr. SEAMANS. It is not casual. It must be carefully managed to be productive but it is still exploratory. The possibilities of this whole area of earth resources, including oceanography, are obviously very exciting. We do not want to be too conservative but we must keep pointing out that we don't yet know what the payoff is going to be or can be, and we won't until we run some additional experiments, particularly using aircraft.

Now, we are thinking in terms of an expansion of the aircraft program to get data from higher altitudes and to get more data, to be able to run more flights. I think at this time that is where the emphasis should be, to broaden out the exploration but not at this time to commit ourselves to any type of operational system, although we must keep this in mind as a possibility.

It is for that reason that we are carrying out these preliminary design studies of possible satellite configurations.

Mr. DREWRY. On page 12 it seems to me you hit a rather strong point on the subject of data management. You say that "The present accumulation of our limited R. & D. experiments signal the need for this facet of a full-system." What kind of timetable do you have on the development of a system?

Dr. SEAMANS. The matter of data management is an area of very major importance, particularly when we consider so-called imaging devices, to send pictures back from the spacecraft by data link which requires a great deal of bandwidth in the transmission system, both in regards to the spacecraft and the ground environment.

At Goddard now, coming back to that spaceflight center, they are carrying out a lot of studies to try to anticipate potential needs of the future. They are looking at ways and means for better storing information in the spacecraft, for even carrying out automatic analyses in the spacecraft to try to minimize the load and the transmission link to the ground, looking at ways and means for improving the refinement of data on the ground once it arrives there, and looking at ways to better transfer the information to the potential users once it has been analyzed on the ground.

This is a very large and important area of technological investigation at this time. The timetable for this depends upon the needs.

What we are studying now are the technologies that we should be working on so that we can provide in a timely fashion a capability when it is required.

Mr. DREWRY. In that connection, recognizing that there are various tools, each one having its place; the aircraft having many uses, ships, buoys, and so on, is there anything being done on an overall basis to try to bring this data management question into a total interdepartmental system?

Dr. SEAMANS. Let me refer this to Mr. Jaffe.

Mr. DREWRY. The data center was set up——

Mr. JAFFE. The Marine Council, sir, is reviewing the data center problem jointly with all of the user agencies concerned. NASA is participating in this review. That is one aspect of the data management problem. So at least this particular aspect is being looked at very carefully.

Mr. DREWRY. Just one other short question. You refer on page 3 to the "all-weather" capability for certain parameters. What would be an example of that as contrasted with clear weather activities?

Dr. SEAMANS. Well, an example could be, say, in the radio frequencies. I think Mr. Jaffe mentioned the use of radiometers to measure a wave height or the sea state. It appears that one of the measurements that could be made quite reasonably precisely from either aircraft or space is the sea state. This can be made through cloud cover.

Mr. DREWRY. That is all I have, Mr. Chairman. Thank you, Dr. Seamans.

Mr. LENNON. Are there further questions, gentlemen?

Mr. KARTH. Mr. Chairman, just one observation which I would like to make for the record. If Dr. Seamans wishes, I will strike it from the record later on so that it does not appear.

I think it is noteworthy that in line with the Chairman's seemingly displeasure of NASA's contributions over the years to the Department of Defense problems, it should be stated that insofar as NASA's activities are concerned, the organic act creating it in 1958 very specifically sets NASA up for the purpose of exploring for peaceful purposes matters of outer space, technological, scientific, et cetera. And also that therefore there is no direct relationship between NASA and the Department of Defense projects or problems as such, but that much of NASA's scientific work in the basic and applied research area has, like oceanography, been inadvertently extremely helpful to solving some Department of Defense problems, and that basic and applied research may very well, on many occasions, have been most helpful to the Department of Defense. This would not appear on the record as such and not be identified or enumerated as specific problems or as specifically helpful areas that NASA has participated in with the Department. I am not sure that Dr. Seamans would want to leave this in the record at this point. If not, I certainly have no objection; but I do think it is noteworthy that we just briefly, at least, explore the reasons why the Department of Defense would probably not want to, for any number of reasons, or in many instances probably not be aware of the basic and applied research experimentations conducted by NASA which have been applicable to Department of Defense problems.

Dr. SEAMANS. Mr. Chairman, I think perhaps your comment related to what Mr. Karth has said as well as to your feeling that we had made perhaps more of a contribution than they were indicating in their testimony. Our business is basically the science and technology related to aeronautics and space. This obviously has ramifications to military as well as to nonmilitary applications. When you get over into the applications area, the act that established NASA put us into the nonmilitary uses.

Clearly, the Department of Defense must be responsible for developing their own weapons systems and defense systems.

However, the science and technology that we are evolving is very much undergirding the DOD endeavor. I know Dr. Foster, for example, my counterpart in the Department of Defense, has clearly expressed this view and I believe has put it in writing in a letter to Members of Congress. So that in the case of aeronautics, we are testing an F–111 out at Edwards and we are running intake studies at our Lewis Center to better understand the performance of the engines of the F–111; but we are looking at it from the standpoint of the aeronautical problems associated with that aircraft. It is up to the military to make the decision how or what modifications might be made to the aircraft. Similarly in space, we did place into orbit a synchronous satellite called Syncom. When we finished our tests we turned this over to the Department of Defense for their use. This was not planned at the start, but it was there and they could use it. Since then they have augmented this communications satellite capability by developing their own and placing their own satellites into orbit.

Mr. PELLY. Mr. Chairman, I referred earlier to what I thought had been a very successful job in overcoming the difficulties of somewhat similar programs. I have in mind, of course, the apparent interagency rivalry involved—which agency of Government was going to do certain types of work. I know contracts were canceled that were being financed through the Air Force and then later almost similar programs were done by NASA. However, I want to convey my impression that a great deal of duplication has been avoided. While this may have left some individual members of the Defense Department a little unhappy, I still think that the way in which the two agencies have worked together in trying to harmonize differences to avoid duplication and waste has been remarkable. As a member of that space committee, I have observed this over a number of years. I think it is my impression that a good job has been done by both sides.

Dr. SEAMANS. We certainly worked hard at it, Congressman Pelly. I am sure that we will continue to work hard at it.

Mr. LENNON. I will not put in the record the exact testimony, though I do recall it verbatim. It came about in discussions of the FOBS, the fragmented orbital bombardment system that we are developing, in another committee. That is when we got into the question. I think it is better for the record to stay the way it is, however.

Are there further questions, gentlemen? If not, Dr. Seamans, we appreciate your appearance and that of your associate. We hope that whoever is going to represent the Department in the future will keep us advised about your participation, even on the spinoff philosophy, in oceanography.

Thank you very much.

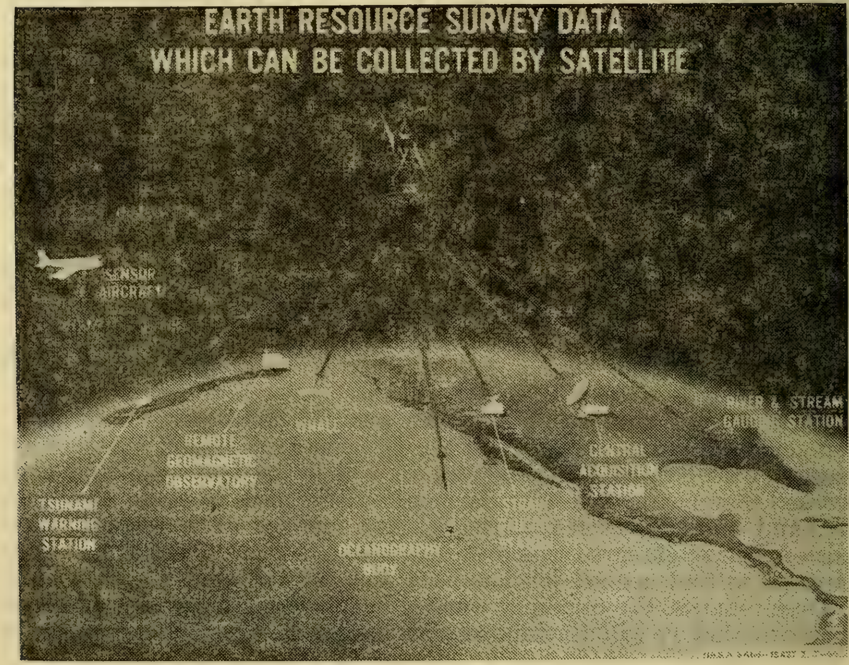
(Documents submitted by Dr. Seamans follow:)

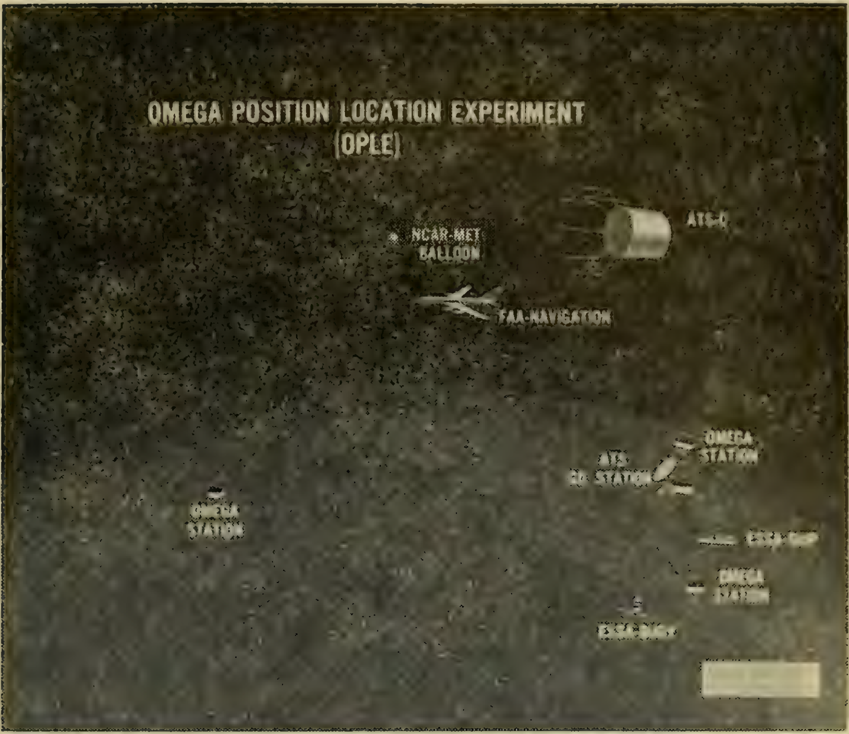
NASA'S ACTIVITIES IN CONNECTION WITH THE LONG-RANGE NATIONAL PROGRAM IN MARINE SCIENCE

CHARTS USED WITH TESTIMONY FOR PRESENTATION BEFORE THE SUBCOMMITTEE ON OCEANOGRAPHY

Chart and Description

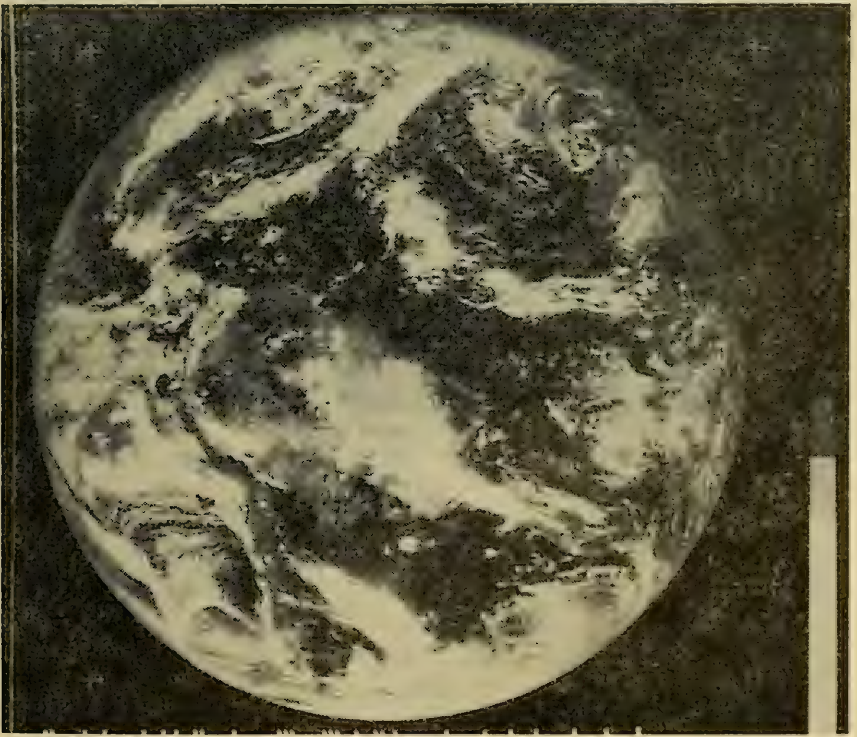
SA66–15477: Earth Resource Survey Data Which Can Be Collected By Satellite.
SA67–2398: Omega Position Location Experiment.
67–HC–723: ATS–III Photo of Earth from 22,300 Miles in Space.
SA68–15458: Potential Oceanographic Observations by Spacecraft.
SA67–15431: Sample of Useful Earth Resources Data Obtained by Nimbus II.
SA67–16937: Application of Space Photography to Hydrographic Chart Compilation and Up-Dating.
SA67–16672: Fish and Mineral Oil Spectral Signatures.
SA68–15007: Aircraft Test Site Program for Oceanographic Studies.
SA68–15217: Gemini V Photo of Rongelap Atoll With Nautical Chart Overlay Shows Application of Space Photography For Updating Hydrographic Charts.


EARTH RESOURCE SURVEY DATA
WHICH CAN BE COLLECTED BY SATELLITE
SENSOR AIRCRAFT
RIVER & STREAM GAUGE STATION
REMOTE GEOMAGNETIC OBSERVATORY
CENTRAL ACQUISITION STATION
TSUNAMI WARNING STATION
OCEANOGRAPHIC BUOY
NASA SA66-15477



OMEGA POSITION LOCATION EXPERIMENT
(OPLE)

ATS-C
NCAR-MET
BALLOON
FAA-NAVIGATION
OMEGA
STATION
ATS
GD STATION
OMEGA
STATION
ESSA-SHIP
OMEGA
STATION
ESSA-BUOY

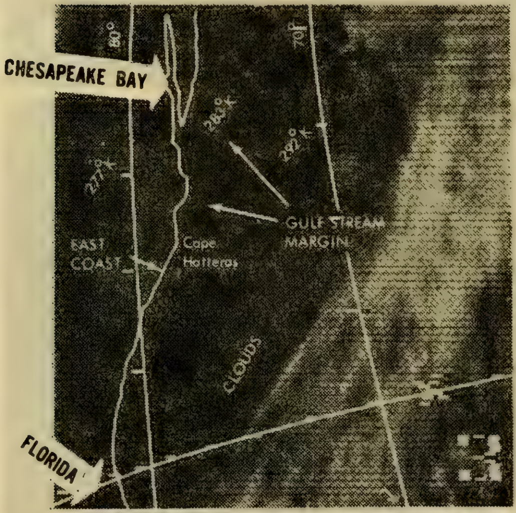


POTENTIAL OCEANOGRAPHIC OBSERVATIONS BY SPACECRAFT

- OCEAN SURFACE AND SUBSURFACE TEMPERATURES AND CURRENTS
- SEA STATE OF THE OCEANS
- INDICES OF BIOLOGICAL ACTIVITY
- COASTAL PROCESSES
- HYDROGRAPHY AND BATHYMETRY
- SEA ICE
- AIR/SEA INTERACTIONS
- MEAN SEA LEVEL
- SALINITY AND WATER DENSITY NEAR SURFACE AND IN SUBSURFACE

NASA HQ SA68-15458
10-20-67

SAMPLE OF USEFUL EARTH RESOURCES DATA OBTAINED BY NIMBUS II



GO-SPOC-8

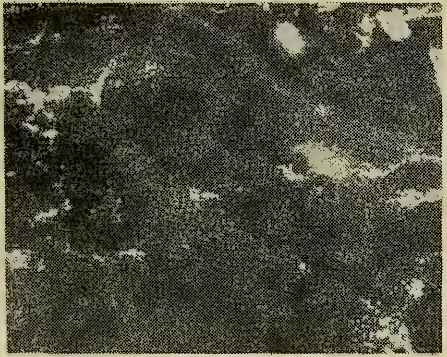
NIMBUS II HIGH RESOLUTION INFRARED IMAGERY CLEARLY DEPICTS THE GULF STREAM. TEMPERATURE VALUES WERE DETERMINED BY MICRODENSITOMETER.

NIMBUS IR IMAGERY CAN BE VERY USEFUL IN DETERMINING THE LOCATION, DISTRIBUTION, AND MOVEMENT OF THE MAJOR OCEAN WATER MASSES.

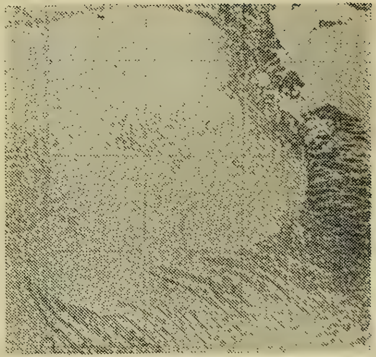
STUDIES OF THIS NATURE WILL BE OF GREAT VALUE TO OCEANOGRAPHERS, METEOROLOGISTS, AND TO THE WORLD'S FISHING AND SHIPPING INDUSTRIES.

NASA HQ SA67-15431
12-5-66

APPLICATION OF SPACE PHOTOGRAPHY TO HYDROGRAPHIC CHART COMPILATION AND UP-DATING



NASA Gemini V Photo 65-45760 by Gordon Cooper and Charles Conrad, obtained 1:39 PM local time August 22, 1965. Altitude about 150 miles. Illustration above is about two thirds of the original photograph.

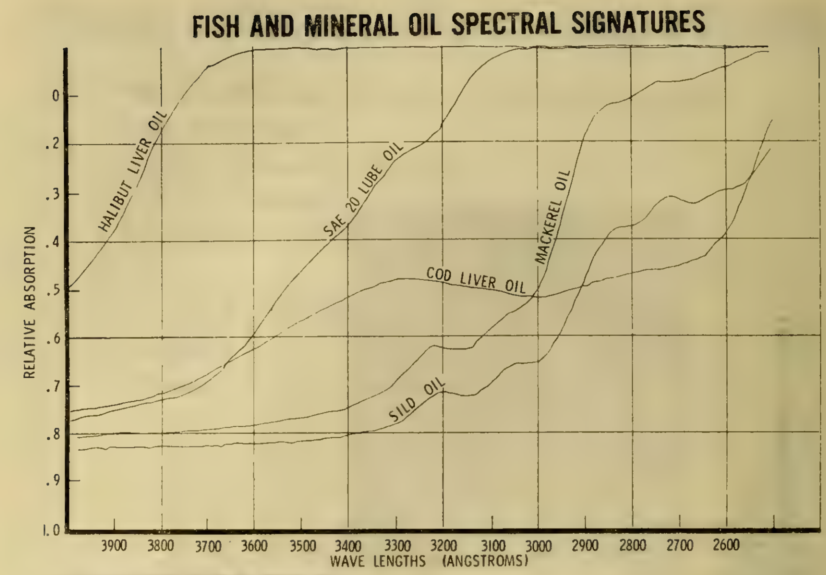


Isodensity photo produced by masking the original negative with a fourth generation positive and printing from this combination. A given density in the original photo is reproduced as a line pattern in the photo here with the lines representing a depth contour on the ocean floor. The red line is about two fathoms.

A single photo obtained fron space provides means for producing a hydrographic chart with depth contours. Comparison of this isodensity photo with chart 5956 shows close correlation, with some differences showing change in position of underwater sand ridges. This method can be used both for original chart compilation and for later up dating of charts at low cost.

Courtesy D S. Ross, Space and Re-entry Systems Division of Ford-Philco Compilation by J F. Seitz, USGS

NASA HQ SA67-16937
6-7-67



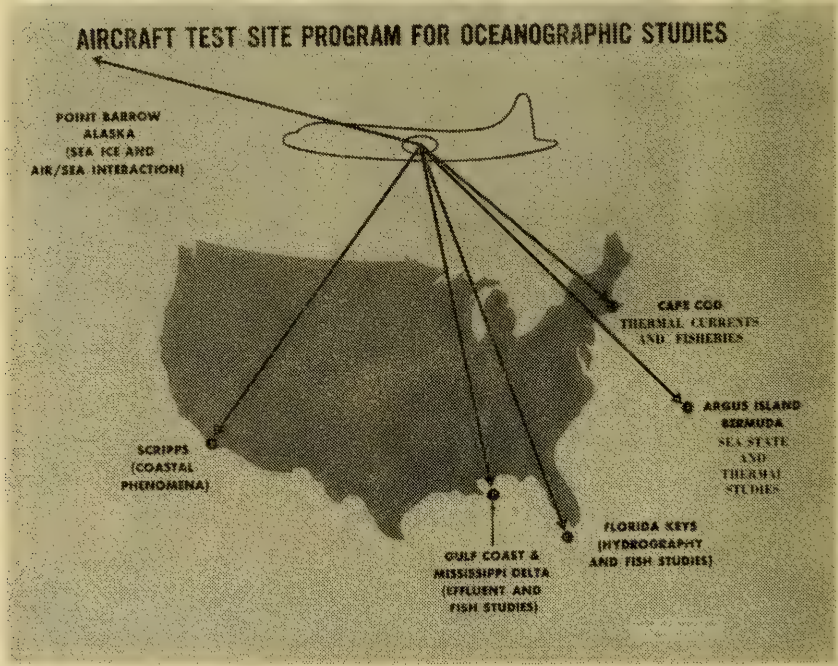
SPECTRAL SIGNATURES OF FISH AND MINERAL OILS

THESE CURVES REPRESENT THE RELATIVE ABSORPTION AT VARIOUS WAVE LENGTHS FOR DIFFERENT OIL FILMS OBTAINED IN THE LABORATORY. EMISSION CURVES OBTAINED WITH AIR- OR SPACEBORNE SPECTROMETERS FROM OIL SLICKS ON THE OCEAN SURFACE WILL GIVE SIMILAR SIGNATURES. LOCATION OF OIL SLICKS FROM WATER POLLUTION, SHIP OR AIRCRAFT DISASTERS, AND SCHOOLING FISH ARE POTENTIAL APPLICATIONS FOR THIS SPECTROMETER.

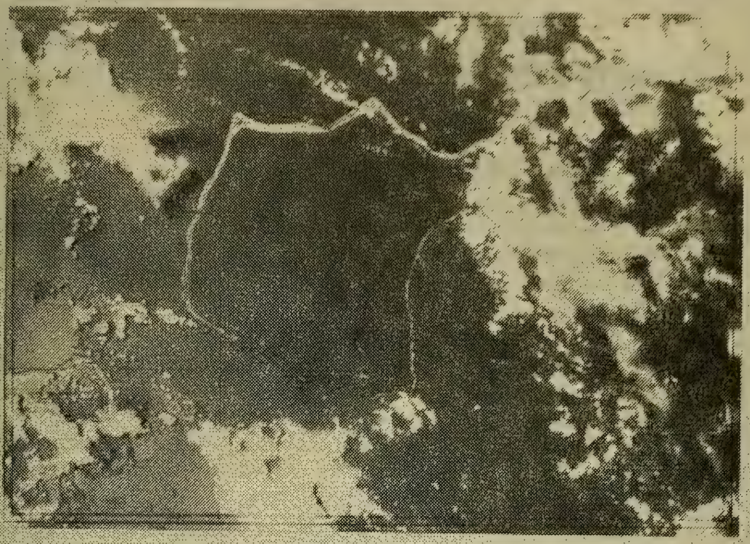
COURTESY OF BARRINGER RESEARCH, LTD.

OCEANOGRAPHY TASK #17
LABORATORY; AUGUST, 1966

NASA HQ SA67-16672
Rev. 5-25-67


AIRCRAFT TEST SITE PROGRAM FOR OCEANOGRAPHIC STUDIES
POINT BARROW
ALASKA
(SEA ICE AND
AIR/SEA INTERACTION)
CAPE COD
THERMAL CURRENTS
AND FISHERIES
ARGUS ISLAND
BERMUDA
SEA STATE
AND
THERMAL
STUDIES
SCRIPPS
(COASTAL
PHENOMENA)
FLORIDA KEYS
(HYDROGRAPHY
AND FISH STUDIES)
GULF COAST &
MISSISSIPPI DELTA
(EFFLUENT AND
FISH STUDIES)

GEMINI V PHOTO OF RONGELAP ATOLL WITH NAUTICAL CHART OVERLAY SHOWS APPLICATION OF SPACE PHOTOGRAPHY FOR UPDATING HYDROGRAPHIC CHARTS



WHERE SURFACE SURVEY DATA ARE AVAILABLE, POSITIONING OF THE ATOLL IS VERY ACCURATE. HOWEVER, IN THE NORTH & NORTHWEST PART OF THE ATOLL, THE CHART SHOWS MANY ERRORS IN POSITIONING AND CONFIGURATION. PHOTO TAKEN FROM 150 MILES ALTITUDE, USING 80MM FOCAL LENGTH LENS ON 70MM FILM.

NASA HQ SA68-15717 2-21-68

Mr. LENNON. Tomorrow, gentlemen, the subcommittee will convene again at 10 o'clock to hear from the witnesses from the Department of State, Mr. Herman Pollack, Director of International Scientific and Technological Affairs. He will be accompanied by Mr. Burdick Brittin, Deputy Special Assistant for Fisheries and Wildlife. Also Mr. David H. Popper, Deputy Assistant Secretary for International Organization Affairs. That will be at 10 o'clock tomorrow morning. We stand adjourned until that hour.

(Whereupon, at 11:50 a.m., the subcommittee recessed, to reconvene at 10 a.m., Tuesday, December 12, 1967.)

NATIONAL MARINE SCIENCES PROGRAM

TUESDAY, DECEMBER 12, 1967

House of Representatives,
Subcommittee on Oceanography of the
Committee on Merchant Marine and Fisheries,
Washington, D.C.

The subcommittee met at 10 a.m. in room 1334, Longworth House Office Building, Hon. Alton Lennon (chairman of the subcommittee) presiding.

Mr. Lennon. The subcommittee will resume its hearings.

The hearing this morning is the final one of the series which started on Augut 17, which was the first anniversary of the convening of the National Council on Marine Resources and Engineering Development.

It was our pleasure on August 17 of this year to hear Dr. Wenk and other members of the National Council, and subsequently we heard from Dr. Stratton, the Chairman of the Commission, the Vice Chairman of the Commission, and other members.

With the testimony to be delivered by the Department of State representatives today we will have heard from all Government departments and agencies concerned in any important way with the national oceanographic program.

As the Chair announced at the commencement of this series of hearings, it is our intention to hear not only from Federal Government agencies but from institutions, States, associations, industry, and other interested individuals and organizations in the private sector.

I hope we will be able to schedule continuing hearings very early in the next session.

We will, of course, plan to devote as much time to such hearings as may be needed in order to gain the maximum broad scale insight into the status and needs of this total program.

This morning, gentlemen, it is our privilege and pleasure to have with us, representing the Department of State, Mr. Herman Pollack, Director of International Scientific and Technological Affairs, accompanied by Mr. Burdick H. Brittin, Deputy Special Assistant for Fisheries and Wildlife, and the Honorable David H. Popper, Deputy Assistant Secretary for International Organizational Affairs.

I understand, Mr. Pollack, that you do have a prepared statement.

Mr. Pollack. Yes, sir.

Mr. Lennon. If you will just proceed, sir, we will move along.

Thank you.

STATEMENT OF HERMAN POLLACK, DIRECTOR OF INTERNATIONAL SCIENTIFIC AND TECHNOLOGICAL AFFAIRS, DEPARTMENT OF STATE

Mr. POLLACK. Thank you, Mr. Chairman and members of the subcommittee, the Department of State is pleased to have the opportunity to discuss its role in the Government's effort to build a national oceanographic program under the Marine Resources and Development Act of 1966.

You will recall that the act specified that "the marine science activities of the United States should be conducted so as to contribute to * * * cooperation * * * with other nations and groups of nations and international organizations * * * when such cooperation is in the national interest." We find ourselves increasingly engaged in that effort.

Mr. David H. Popper, Deputy Assistant Secretary for International Organization Affairs, and Mr. Burdick H. Brittin, Deputy Special Assistant to the Secretary for Fisheries and Wildlife, are with me to provide any information you may wish within their fields of activity. Also Mr. Stanley N. Futterman, Legal Adviser's Office.

First, I should point out that the Department of State is not an operating agency in the field of oceanography We conduct no scientific research per se. We do not operate any research vessels or submersibles. We run no laboratories. Nor do we conduct any operating programs having to do with the exploration of the oceans or the use of its resources.

Rather, it is the Department's task to understand and make arrangements to meet national needs in this area, insofar as they involve or affect the foreign relations of the United States and its posture in the world.

This means the negotiation of arrangements with other countries to meet a broad spectrum of requirements ranging from specific research projects to complex legal matters such as those involved in the 1958 Geneva Conventions concerning the law of the sea, and their possible future modification.

This means identifying opportunities in this field which can be used for the benefit of our overall national objectives abroad.

It necessitates relating the diverse international programs of Government agencies and private organizations to clear, attainable national objectives.

It requires an understanding of the interests and capabilities of other nations in this field.

It concerns international ground rules for scientific investigation of the oceans and for exploitation of their resources, cooperation with other countries, the development of means to promote our national interests, including security requirements, while commodating the interests of other nations.

It is thus our purpose to achieve broadly acceptable international arrangements that will encourage the development and use of the resources of the oceans and that will avoid dangerous conflicts among nations exploiting these resources. We must do this without compromising our national security. We must at the same time enhance our commercial and industrial capabilities. Needless to say, this is a complicated task.

It may be worth noting that it is not so much the scientific exploration of the oceans which creates international problems as the development and application of the technology for exploitation of their resources. This latter will involve a substantial investment, a large potential for profits, and questions of ownership, sovereignty and national security. It is a high-risk venture.

I need not point out to this subcommittee that we appear to be on the threshold of a quantum jump in interest and activities in this field—political as well as scientific, industrial, and commercial. In recent years we have seen an upsurge of interest, both here and abroad, in all phases of marine activity, especially in those having to do with the ocean depths and the seabed and subsoil of the oceans. Today we find the world turning its attention to the oceans beyond the Continental Shelf and seeking an internationally agreed modus operandi for the development and use of their resources.

Let me turn now to the specific involvement of the Department of State.

First, certainly in terms of historic involvement and experience, the Department is heavily engaged in international arrangements concerning fisheries. To carry out these responsibilities there is within the Department an Office of the Special Assistant to the Secretary for Fisheries and Wildlife, headed by Ambassador Donald L. McKernan. The Special Assistant is charged with the implementation of U.S. international fishery policy. To a large degree this is accomplished through U.S. participation in eight different international fisheries commissions, involving some 25 foreign countries, and in worldwide organizations such as the FAO. Through these organizations, the focus of our effort is to achieve rational utilization and conservation of the living resources of the high seas. In addition the Special Assistant is responsible for conducting negotiations with foreign governments concerning specific fishery problems of mutual concern such as those involved in the agreements reached with the Soviet Union, Japan, and Mexico during the current calendar year. I understand that the Committee on Merchant Marine and Fisheries has been briefed in detail on these negotiations by Ambassador McKernan; the last such briefing having occurred on December 4.

Next, we are increasingly involved in the programs and plans of international intergovernmental bodies whose interests focus directly on oceanography or impinge on the exploration and use of the resources of the oceans—particularly the United Nations and its specialized agencies. For example, we are directly engaged within the Intergovernmental Oceanographic Commission of UNESCO in its consideration of scientific activities in oceanography, the Food and Agriculture Organization in its concern with fisheries; the World Meteorological Organization in its arrangements to study the effect of the oceans on climate; the International Maritime Consultative Organization with respect to shipping problems and the safety of lives at sea; and the International Telecommunications Union in connection with ocean communications.

We are also involved directly in arranging, or supporting, bilateral and multilateral cooperative projects with foreign governments and foreign scientists in this field; for example: the recent worldwide cruise of the *Oceanographer* and such research undertakings as the Indian Ocean expedition under the auspices of the Intergovernmental Oceanographic Commission.

Finally, we are increasingly involved in that policy planning process which concerns the development of a coherent body of objectives and a comprehensive plan for their achievement. This is the central task to which I referred at the outset of my remarks. This task goes hand in hand with the development of a national oceanographic program as conceived by the Congress when it enacted the Marine Resources and Development Act. It is both a product of, and a prerequisite to, the development of such a program.

In all of these tasks the Department relates closely to the other Departments and agencies which are involved. The Secretary of State is a member of the National Council on Marine Resources and Engineering Development. The Department is represented on the four committees of the Council which concern (1) ocean exploration and environmental science services, chaired by Dr. White of ESSA, (2) marine research, education, and facilities, chaired by Dr. Frosch of the Navy, (3) food from the sea, chaired by Mr. Waters of AID, and (4) multiple uses of the coastal zone, chaired by Dr. Cain of the Department of the Interior.

In addition, nearly a year ago the Department of State established an Ad Hoc Committee on International Policy in the Marine Sciences, whose function it was to advise the Secretary and, through him, the Marine Council, the Vice President, and President on international policy problems in this field. That committee was an interagency body, chaired by the Department of State and composed of the Executive Secretary of the Marine Council and representatives of the Special Assistant to the President for National Security Affairs, the Office of Science and Technology, the Bureau of the Budget, Navy (for the Department of Defense), Interior, Commerce, Transportation, HEW, the AEC, ACDA, AID, NSF, NASA, and the Smithsonian Institution.

The purpose of the ad hoc committee was to make a broad survey of international problems and opportunities in oceanography, and to commence the identification of policies and arrangements to deal with them. To this end it created a number of temporary interagency panels to look into such matters as scientific cooperation, the exploration and use of the mineral resources of the deep ocean floor, undersea technology, the living resources of the oceans, and regional cooperation in South America and Europe, including the national security aspects of the foregoing matters. It was this ad hoc committee, for example, which was used as the interagency mechanism for developing the position taken by Ambassador Goldberg on the Malta proposal which has been before the General Assembly of the United Nations this fall.

The ad hoc committee has now served its initial purpose. With the agreement of the Vice President, the Secretary of State has converted it into a permanent Committee on International Policy on the Marine Environment. The permanent committee is a smaller group, chaired by the Deputy Under Secretary of State for Political Affairs. Its regular interagency membership includes those officers and agencies having a primary concern with its subject matter. Some of the earlier tasks which were undertaken by the ad hoc committee, now better understood with respect to their international implications, will be carried forward by other departments and agencies directly or by the appropriate committees of the Marine Council. The permanent committee will now focus its attention on a few major problems and opportunities involving the most pressing international aspects of oceanography. It will also carry forward the work in coordinating our involvement in international oceanographic programs which was formerly the task of the Panel on International Programs of the Interagency Committee on Oceanography (PIPICO).

Perhaps a major aspect of the initial work done by the ad hoc committee could be illustrated by summarizing briefly the course of action taken in dealing with the Pardo proposals in the General Assembly of the United Nations. The debate in the General Assembly has exposed—at the present early state of their development—many of the major policy issues which confront us for the immediate future.

You may recall that, under U.S. leadership, the Economic and Social Council of the United Nations had asked the U.N. Secretary General in mid-1966 to make a survey of the current state of knowledge of the resources of the sea beyond the Continental Shelf, excluding fish, and of the techniques for exploiting them. Building on this foundation, the U.N. General Assembly a year ago asked the Secretary General to broaden this study, so as to survey also the activities of member states and intergovernmental organizations in this field and to formulate proposals for insuring the most effective arrangements for an expanded program of international cooperation. The Secretary General was directed to report to the U.N. General Assembly next fall.

These were the first major steps taken within the United Nations toward addressing the questions whether we may not need new ground rules, or new international arrangements, concerning the deep oceans and their resources, and whether we may not need a concerted international effort to stimulate further scientific exploration and education in this field. Essentially, this is what the discussion in the United Nations is all about.

The focal point for discussion in the General Assembly this fall has been the proposal made by Ambassador Arvid Pardo, the representative of Malta. Ambassador Pardo proposed that the Assembly look toward a new international treaty which would reserve the ocean floor beyond the limit of national jurisdiction exclusively for peaceful purposes and establish an international agency to assume jurisdiction over the deep ocean floor and its resources. It was his suggestion that the financial benefits from the exploitation of these resources were to be allocated primarily to the less-developed countries.

In debating this proposal the Assembly has started a dialog on complex and difficult questions affecting law, arms control, international cooperation, management and regulation, and economic development. Yet, no one has a clear understanding of the full implications of the Pardo proposal.

We have little knowledge of the factors involved in exploiting the resources presumed to exist on the deep ocean floor, but not actually located. It is not clear how competent private or public organizations can be induced to undertake the risks of deep-seat exploration and exploitation, if the financial benefits are to go to others. Nor is there yet broad agreement on the general legal principles which ought to govern activities on the deep ocean floor. We are far from ready to establish a new international organization to preside over this amalgam of uncertainties.

Our own position, as set forth by Ambassador Goldberg on November 8, stressed the importance of comprehensive and responsible study, the need for international cooperation in exploration of the ocean floor, and the requirement to develop general principles to guide activities undertaken in this field.

> He pointed out that the deep ocean floor should not become a stage for competing national sovereignties, but, rather, should be open to exploration and use by all states, without discrimination.
>
> Recognizing that the principal issue before the Assembly was how to organize itself to deal competently and knowledgeably with these issues, he recommended the establishment of a committee on the oceans which could advise the General Assembly in considering all marine questions brought before the Assembly. We conceived that such a committee would assist the General Assembly in promoting long-term international cooperation in the marine sciences and, in particular, assist the Assembly on questions of law, crime control, and problems of pollution.
>
> He emphasized the complexity of these issues and noted the considerable body of existing international law and treaty rights and obligations which bear on the subject. He affirmed the willingness of the United States to participate fully in whatever studies are necessary in determining the future legal regime of the deep ocean floor.

I have reviewed in some detail the position taken by the United States in the General Assembly because it remains essentially our position today.

Some four dozen countries have spoken in the debate on this subject in the Political Committee of the General Assembly, representing a wide range of attitudes and uncertainties. Their views run all the way from an apparent willingness by some to act now to adopt several of the principles suggested by Ambassador Pardo to a reluctance, on the part of others, to have the General Assembly involve itself in these issues or to create a special committee to consider them seriously.

> Many countries are worried as to how the involvement of the Assembly, or the work of such a committee, would relate to the responsibilities of the several specialized agencies which are already heavily engaged in this field.
>
> Others feel that many of these matters should best be left to direct negotiations among the countries specifically involved.
>
> There is as yet no clear understanding of what is meant by reserving the deep ocean floor exclusively for peaceful purposes, or how this might be accomplished, or even what basic terminology should be used.
>
> There is no common view as to the limits of national jurisdiction over coastal waters or the adjacent ocean floor. Some advocate, nonetheless, a freeze on the extension of sovereignty or sovereign rights.

> There was throughout the debate a sensitivity on the part of developing countries to this new manifestation of the technological gap, evidenced, for example, by suggestions that there be no unilateral exploitation of the resources of the deep ocean floor.

In these respects, and others, there is no consensus among the member states on the issues themselves, or how best to tackle them on a comprehensive, long-range basis.

The Political Committee of the General Assembly has now agreed on a proposed resolution which, when adopted by the Assembly, will complete the consideration of these matters by the United Nations this year. The resolution would establish an hoc committee for 1 year, composed of 35 members, and charged to study further the scope and various aspects of the matters under debate. It would call also upon the ad hoc committee to include in this study:

> 1. A survey of the activities of the United Nations and its specialized agencies, and of existing international agreements with respect to the matters under debate;
>
> 2. An account of scientific, technical, economic, legal, and other aspects involved; and
>
> 3. Suggestions regarding practical means to promote international cooperation in the exploration, conservation, and use of the ocean floor.

Mr. Popper is prepared to discuss further the nature and import of these actions within the United Nations.

Thus we confront serious issues having to do with the scientific exploration of the oceans, the use of their resources, and the avoidance of conflict. These issues pose difficult and complex problems. Their resolution will require very careful preparation within the United States by industry, commerce, and academic and research institutions, as well as the Congress and executive branch of the Government.

The Department of State is devoting increasing energy and attention to these matters. We shall continue to consult with the subcommittee, and with the other committees of the Congress which are concerned with these matters, as we work toward a better understanding and suitable courses of action.

Mr. Lennon. Thank you very much, Mr. Pollack, for a very informative and to me a very helpful statement on this problem.

The gentleman from Washington, Mr. Pelly.

Mr. Pelly. Thank you, Mr. Chairman.

I think those of us who have participated in previous discussions concerning the Malta resolution in the United Nations probably will have a number of questions.

I personally wish to thank the Department of State for sending me a copy of the statement of Ambassador Goldberg. I hope that in the future we can receive any matters which you might think would help in this respect.

Mr. Pollack. We will do our best to keep you informed.

Mr. Pelly. Yesterday, Dr. Seamans of NASA testified before this subcommittee. He addressed his remarks to many of the space-oceanographic developments. One of the questions which arose was with regard to international agreements in connection with the space agency. According to law, such agreements generally do require approval of the Congress—in other words, with regard to any joint ventures in which we might engage.

Is this also true concerning matters which relate to the ocean's floor and bed or the ocean itself?

Mr. POLLACK. I am not aware of any legislative requirement that would be applicable to the ocean bed or the ocean floor.

Mr. PELLY. I always thought that the Congress had the right of approval with regard to any international agreements or joint arrangements. Of course, there also might be executive agreements. However, concerning the ocean floor, where I thought we already had established rights by international convention, it caused me some worry.

Consequently, I am particularly interested in following up events in the United Nations. I know all the other Members of Congress share a similar interest.

I have received a legal memorandum from the Law Division of the Library of Congress indicating that the disposal of U.S. property—and I assume that would mean material property—the approval of both Houses of Congress is required under the Constitution.

Under the 1958 Geneva Convention if the floor of the ocean was yielded to any international agency, would this require the consent of both Houses of the Congress?

Mr. POLLACK. Of course, the conventions were ratified by the Senate and any modifications in those conventions would have to be.

Mr. PELLY. The convention of 1958?

Mr. POLLACK. Yes, sir; all of those.

Mr. PELLY. Once that ownership is established through an international convention, which has been duly approved by the Senate, then my question is whether the consent of both Houses of the Congress is required to transfer such ownership to an international body?

Mr. POLLACK. I cannot answer that question as an expert, but it is my impression that the requirements of the Constitution call upon the Senate to provide the advice and consent in effect to what constitutes a treaty.

Mr. PELLY. In other words, if we surrender our sovereign rights in Panama, then is it your opinion that this could be done by Senate approval only and not both the House and Senate?

Mr. POLLACK. May I turn to Mr. Futterman who is from our legal adviser's office because this is a legal question?

Mr. FUTTERMAN. I do not have the Constitution of the United States before me, but my memory of it is that it prescribes that the law of the land includes laws passed by Congress, of course, and treaties which are put in force with the advice and consent of the Senate. So I think, based on that, it would seem that treaties have an equal status with laws which are passed by both Houses of Congress.

Mr. EDWARDS. Will the gentleman yield?

Mr. PELLY. Yes.

Mr. EDWARDS. Is it not a question of whether title to the land is vested in the United States as a result of the convention which was ratified by our Senate? Is that not the question?

Mr. PELLY. Yes.

Mr. EDWARDS. And once title is vested, if in fact it is, then would it not require the vote of both Houses of Congress in order to dispose of that title or any right in that title? Is that not the question?

Mr. Pelly. That is my exact question. Would you prefer to submit your opinion on this issue for the record? It certainly is of vital interest to all of us on this subcommittee, as well as the full committee.

Mr. Pollack. We obviously do not have the answer to the question at this moment.

Mr. Pelly. Nevertheless, I would like to know the opinion of the Department of State. It is of vital interest to us. I think it only fair not to presume that anyone could give an off-the-cuff opinion on such an important matter.

Mr. Lennon. I assume the gentleman is requesting the Department of State and the Department of Justice to furnish for the record an explicit definitive answer on the question of the gentleman from Washington as supplemented by the remarks of the gentleman from Alabama. Would there be any objection to doing that?

Mr. Pollack. No, sir; we will do our best to supply the answer to the question.

Mr. Lennon. I hope it will be illuminating.

(The information follows:)

U.S. Jurisdiction Over the Continental Shelf

The question has been raised whether any diminution in the nature or extent of US jurisdiction over the continental shelf, as provided for in the Convention on the Continental Shelf, could be accomplished by treaty, or whether the action of both Houses of Congress would be required.

Broadly speaking, there are two sorts of international arrangements concerning the continental shelf to which the above question may be addressed. One such type of arrangement would involve divestment of U.S. jurdisdiction over its continental shelf. There has been no proposal that we enter into any arrangement of the first type nor do we contemplate doing so.

The other sort of arrangement would involve clarifying or supplementing the Convention on the Continental Shelf by providing a more precise delimitation of the extent of the continental shelf. Such an arrangement would be in the nature of a boundary determination which typically has been accomplished by treaty rather than legislation.

Mr. Pelly. I think that such a legal opinion is something all of us want very much, especially in view of the Malta Resolution.

I have one or two other questions which I have noted on your very fine prepared statement. Referring to page 14 of your statement where you cite the remarks of Ambassador Goldberg, you say he pointed out that the deep ocean floor should not become a stage for competing national sovereignties. Rather, it should be open to exploration and use by all states, without discrimination.

What I would like to know is what did Mr. Goldberg mean when he talked of "without discrimination"? Does this mean that if you are a nation which does not have any coastal areas of your own, you have a full free right to go into somebody else's coastal area? I think it would be interesting to get some clarification of that particular statement. Would you like to submit that for the record or are you prepared to answer now?

Mr. Pollack. It should be pointed out we are speaking here about the deep ocean floor rather than the coastal areas.

Mr. Pelly. If it is subject to development by a coastal state beyond the Continental Shelf, then it seems to me under the 1958 Geneva Convention there are exclusive rights given to the coastal states to exploit any resources that might be there if they can do so.

My question is, does this statement reverse that policy so as to open it to any nation in the world to come into the area beyond the Continental shelf and to exploit it regardless of the activity of any adjacent coastal state?

Mr. POLLACK. I think, Mr. Congressman, Ambassador Goldberg's statement envisages a point beyond the Continental Shelf as defined in the existing conventions, which would be known as the deep ocean floor. I do not know what that point is; I do not think anybody knows at this point what that point is. But this is one of the issues I described in my remarks as being difficult and complex and that will require study and consideration and dialog among the interested nations.

Mr. PELLY. I would hope some way may be found to restrict preference to those nations which establish rights by going out into the area to sink oil wells, for example, and to try exploiting the resources. I would certainly hope we are not opening the door now for anybody to walk in beyond the 12-mile limit or 3-mile limit and suddenly say, "Ambassador Goldberg has already declared that is open for anyone to come in."

Mr. POLLACK. I do not think this is what Ambassador Goldberg intended to say and I do not think anyone understood him to say that.

Mr. PELLY. I am glad to hear that. I thought it should be somewhere in the record so we can point to it.

Mr. LENNON. Will the gentleman yield?

Mr. PELLY. Yes.

Mr. LENNON. In the discussion of this matter earlier with members of the National Council, it was agreed that the committee would be furnished the full text of the statement made by Ambassador Goldberg on this subject. If the committee has not received it, I would request the Department of State to furnish it for the record.

Mr. PELLY. I believe that we have received it, Mr. Chairman. I am sure I have it on my desk.

Mr. LENNON. Without objection then, it will be entered in the record at this point. And without objection, if the Department of State would give us a legal analysis and brief of the interpretation of the statement as related to the question by the gentleman from Washington immediately following the insertion in the record, it will be included.

(The information follows:)

"DEEP OCEAN FLOOR" STATEMENT BY U.N. AMBASSADOR GOLDBERG

The question has been raised whether one particular sentence in Ambassador Goldberg's statement of November 8, 1967, in Committee 1 of the UN General Assembly, amounted to an invitation to other states to exploit the mineral resources of the sea bed off the coast of the United States. The sentence is "whatever legal regime for the use of the deep ocean floor may eventually be agreed upon, it should assure that the deep ocean floor will be open to exploration and use by all states, without discrimination."

Ambassador Goldberg was amplifying President Johnson's statement of July 15, 1966, on the occasion of the commissioning of The Oceanographer. In that statement, President Johnson had said: "Under no circumstances, we believe, must we ever allow the prospects of rich harvest and mineral wealth to create a new form of colonial competition among the maritime nations. We must be careful to avoid a race to grab and to hold the lands under the high seas. We must ensure that the deep seas and the ocean bottoms are, and remain, the legacy of all human beings."

Ambassador Goldberg's statement relates only to the "deep ocean floor." It is clear from other parts of the statement that by "deep ocean floor" was meant the sea bed and subsoil beyond the continental shelves over which coastal states exercise soverign rights. Thus, Ambassador Goldberg stated that "I do not wish to imply that the task of developing legal principles for the deep ocean floor will be simple. The question of definition of the deep ocean floor will have to be considered. The work will have to take into account existing treaties, including the Convention on the Continental Shelf. These treaties confer rights which are valued and retained by the signatories."

The Continental Shelf Convention establishes the regime governing exploration and exploitation of the continental shelf. Under this regime the coastal state possesses certain exclusive rights. Ambassador Goldberg's statement makes clear the intention of the United States that whatever regime is adopted for the areas beyond the continental shelves it should provide all states with an equal opportunity to explore and use this area.

Mr. PELLY. I would like to express my commendation for that part of the statement of Ambassador Goldberg's where he says we are not ready to establish a new international organization to preside over this amalgam of uncertainties. I certainly agree with that view.

I have just one other question. I hope I am not taking too much time, Mr. Chairman, but this is a matter of great interest to me.

You referred in your statement to negotiations with various foreign nations concerning specific fishery problems. I cannot find that particular part of your prepared statement at the moment. However, we were briefed very recently by Mr. McKernan on some of our fisheries' difficulties. It seems to me that where, for example, we have had many of our fishing vessels seized—and there is a tremendous problem in this respect involving certain Latin American countries concerning fishing rights—could not the Department of State suggest that pending international settlement of the extent of a coastal State's jurisdiction over free swimming fish—be it 200 miles, 100 miles, or 12 miles—we all agree to leave the issue for some future settlement. Meanwhile, we might work out some temporary arrangement based upon historic rights since our fishermen have gone down there throughout history, and ask such nations to stop harassing our fishermen in recognition of the fact that they have pioneered the fishing resources outside the 12-mile limit. Then, perhaps we on our part might agree to pay their license fees for fishing within the 12-mile limit. I certainly would hope we could settle this matter.

Today, as I'm sure you know, there is a measure coming before the House concerning the loan of naval vessels to foreign nations. It provides that the President shall—not may—shall cancel any such loan of naval vessels if the foreign nation seizes our fishing vessels. Certainly, this is a poor way to settle disputes, but it is about the only recourse open to us at this time.

Would you care to comment on that subject?

Mr. POLLACK. Let me ask Mr. Brittin to answer that.

Mr. BRITTIN. Thank you.

Congressman Pelly, as you were briefed, sir, on December 4, our central thrust is to try to get the countries concerned to the negotiating table, and some of the areas you have touched on, sir, are part and parcel to what we are talking about.

Mr. PELLY. Is historic rights one of them?

Mr. BRITTIN. We do not label it precisely as such, but we are persuing it because of the classic period of time we have been involved in that particular area.

Mr. Pelly. I urge you to pursue every possible avenue and to settle this matter. We are coming into a difficult period with the beginning of the new season. There are sure to be problems concerning foreign aid and other international matters of interest to the Department of State.

Not being on the Committee on Foreign Affairs, I do not have much of a chance to talk to you. However, I would appreciate anything you can do to pursue and to resolve the matter.

Mr. Lennon. Will the gentleman yield on this point?

Mr. Pelly. Yes.

Mr. Lennon. Some 10 days ago an article appeared in the news media of the country that an arrangement had been worked out with the Soviet Republic that would permit the Soviet Union, their fishing trawlers, mother fleet, and all, to come within the 12-mile fishing limit in consideration of their willingness to take less of a certain type of white fish and hake. Something of that kind.

The Congress is cognizant of the fact that this committee reported out a bill which was finally signed into law by the President which gave this country exclusive fishing rights out to the 12-mile limit beyond the so-called 3-mile international waters as historically recognized.

I was contacted immediately by telephone and wire for the basis upon which the Department of State negotiated an agreement with a foreign country which in substance and in a practical effect negated the law of this land which gives our fishermen the exclusive right out to the 12-mile fishing zone.

On December 4, Mr. McKernan of your Department was here and appeared before the Fish and Wildlife Subcommittee, of which I am a member and which I could not attend because I was chairing a Subcommittee of the Armed Services that day. That was a closed hearing.

I would like to ask two things be done. I would like to obtain, and the committee would like to obtain immediately a sanitized version of Mr. McKernan's statement before this committee in order that we in turn can release it to the people who have wired, who have written, who have called, raising the question of the authority of the Department of State to violate a law passed by this Congress, signed into law by this President without any prior notice to the Congress. The first notice we got that this was being done was when we read in the paper it was an accomplished fact, and that is a thing that is of some consequence to a lot of people.

I do not want to release it, do not intend to release the so-called statement made by Mr. McKernan in explanation of this because it was a closed session, but I shall do it if I do not have in my hands within the next 48 hours a sanitized version of Mr. McKernan's statement that I can send to the people who are concerned on the question of how it is that the Department of State, in the interests of international good will and also to protect our own fishermen, can violate the laws of the Congress. No. 1.

(See hearings entitled, "Fisheries Agreements and Negotiations," serial No. 90–13, printed by the committee.)

Mr. Lennon. Then I would like for the Department of State, the Legal Department, if you will, supplemented by the Department of

Justice, to insert in the record following the statement I am making its determination of the legal right of a department of the Federal Government to make an agreement that violates a law of the United States without first coming back to Congress and at least getting, not its acquiescence because the Executive rarely does that any more, but at least putting us on notice that the law is going to be violated.

Will you gentlemen do that because we have to answer to our constituency, you gentlemen do not. You are not elected, we are, and we have to answer these things. You gentlemen can just say, "Well, it happened." Will you not do that for us?

Mr. POLLACK. We will be glad to.

Mr. PELLY. I think it should be pointed out when we reported out the bill from this committee which was subsequently passed by Congress and signed by the President, there was an exception concerning the continuation of traditional fishing within the 12-mile zone as may be recognized by the United States.

Mr. LENNON. I am recalling off the top of my head and that is undoubtedly the explanation. But until such time as we get a sanitized version of this from State, it is difficult to explain because the people have the same impression I gave you a few minutes ago.

Mr. REINECKE. Mr. Chairman, I would like to ask these gentlemen also to advise the committee in the same report as to why they are willing to negotiate to the extent just described with the Soviets and yet have not seen fit to start similar negotiations to protect the life and property of our own citizens off the coast of South America.

Mr. LENNON. They can answer that too for the record.

(The information follows:)

U.S. RIGHTS ON THE CONTINENTAL SHELF

The question has been raised as to how far out from shore United States rights extend under the Convention on the Continental Shelf.

Article I of the Convention on the Continental Shelf provides:

"For the purpose of these articles, the term 'continental shelf' is used as referring (a) to the seabed and subsoil of the submarine areas adjacent to the coast but outside the area of the territorial sea, to a depth of 200 meters or, beyond that limit, to where the depth of the superjacent waters admits of the exploitation of the natural resources of the said areas; (b) to the seabed and subsoil of similar submarine areas adjacent to the coasts of islands."

Under this definition it is clear that the continental shelf, over which the coastal state exercises sovereign rights for the purpose of exploring and exploiting its natural resources, extends at the minimum to that distance from shore at which the superjacent waters are not deeper than 200 meters. It is equally clear under the Convention that the continental shelf may extend some further distance if the depth of the superjacent waters still admits of the exploitation of the natural resources, so long as the areas in question are still "adjacent to the coast." The meaning of adjacency is not altogether clear in this context, and the negotiating history of the Convention does not add greater precision. At the time the Convention was drafted it was recognized that the definition of the continental shelf provided a measure of elasticity and vagueness. However, the possible disadvantages of this lack of precision do not seem to have been of particular concern, apparently because it was assumed that exploitation at depths very much greater than 200 meters was still a number of years away.

The negotiating history of the Convention does make clear that it was not contemplated that the continental shelf would extend to midpoint in the ocean even if exploitation at all depths should become possible. Presumably it was thought that coastal states would be entitled to sovereign rights for the purpose of exploration and exploitation beyond the 200 meter depth so far as the international community was prepared to accept coastal jurisdiction as appropriate. This seems to be the significance of the term "adjacent."

It has now become apparent that exploitation well beyond the 200 meter depth is now or will become feasible. As a result there is considerable interest in more precisely definining the extent of coastal state rights and the legal regime that should govern the exploitation of resources beyond the continental shelves. This effort involves a number of interests and complicated issues and undoubtedly will take some time.

Mr. LENNON. I recognize the gentleman from Minnesota, Mr. Karth.

Mr. KARTH. Thank you, Mr. Chairman.

I would just like to refer back to the colloquy that you and Mr. Pelly engaged in with reference to Ambassador Goldberg's statement. I wonder whether or not Ambassador Goldberg's statement, which included those words "without discrimination," was meant to be in consonance with the freedom of the seas doctrine wherein no nation is restricted really from operating on the seas so long as they do not violate the coastal rules or regulations or laws that have been agreed to and which give certain rights to those nations that do have a coastal area.

Would you comment on that?

Mr. POLLACK. Let me ask Mr. Futterman to comment.

Mr. FUTTERMAN. Mr. Goldberg's statement, if I may quote it exactly, was "Whatever legal regime for the use of the deep ocean floor may eventually be agreed upon, it should assure that the deep ocean floor will be opened to exploration and use by all states without discrimination."

The purpose of this statement was not attempt to prejudge what the regime for the use of the deep ocean floor would be. Rather, it was intended to make perfectly clear that whatever regime would be decided upon ultimately, it should include the basic principle that all states would have access to the exploration and use of the seas without discrimination.

Mr. KARTH. Irrespective of whether they have a coastal area or not?

Mr. FUTTERMAN. This would include states that do not have a coast.

Mr. KARTH. If that is the intent and purpose upon which it is predicated; frankly, I agree. I do not see how we, because we do have a coastal area, could say to those nations unfortunate enough not to have one, that they cannot operate on the high seas insofar as it relates to research and development of resources outside the coastal limits of those nations that do have a coastal zone.

Mr. PELLY. Will the gentleman yield?

Mr. KARTH. Yes.

Mr. PELLY. I think this matter can be viewed as one of free and innocent passage and the right to use international waters. However, that is a little different, it seems to me, when it might be important for some small state to come into the waters adjacent to some coastal state and exploit and develop resources there.

Mr. KARTH. If the gentleman is talking about adjacent waters, I think that is one thing. If he is talking about the Continental Shelf, that in many ways belongs to coastal states, that is another thing. But I think insofar as a state operating outside of the coastal area, I do not see how we could take a position that because some nations are so unfortunate as to not have a coastal area, they cannot involve themselves in the research and development of resources on the high seas outside those coastal areas. I just do not see—even though I would like to, from a parochial standpoint, agree with the gentleman from Washington, I do not see how it is possible or reasonable for us to take any other position.

Mr. PELLY. I think we are in agreement.

Mr. LENNON. The gentleman from Alabama, Mr. Edwards.

Mr. EDWARDS. Do we not have a space treaty now?

Mr. POLLACK. Yes, sir.

Mr. EDWARDS. Is there any parallel or similarity between the terms of the space treaty and Mr. Goldberg's statement concerning the ocean floor insofar as competing national sovereignties are concerned on exploration and this sort of thing?

Mr. POLLACK. Yes; there are parallels.

Mr. EDWARDS. Is it fair to suggest that perhaps the Goldberg statement on the deep ocean was patterned after the space provision?

Mr. POLLACK. No; I do not think I would respond in the affirmative to that. The two situations are different and the problems that we are going to face in coming to an appropriate regime are quite different.

Mr. EDWARDS. You gentlemen were here some time ago and discussed the Pardo resolution with this subcommittee.

Mr. POLLACK. Yes, sir.

Mr. EDWARDS As I recall, I asked then if you had any knowledge of who was behind the Pardo resolution. At that time, one of you gentlemen stated that you did not. In effect, you suggested that Ambassador Pardo was a person who sort of liked to go around introducing new thoughts and new resolutions. Am I substantially stating what you said?

Mr. POLLACK. That is right.

Mr. EDWARDS. Now, as Ambassador Goldberg's position develops, we appear to be heading toward some type of international organization, the question again comes to my mind about who is behind the Pardo resolution. Did the United States have anything to do with the Pardo resolution?

Mr. POLLACK. Let me ask Mr. Popper to answer.

Mr. POPPER. No, sir; the U.S. Government had no part in stimulating or supporting or preparing the Pardo proposals.

Mr. EDWARD. When was the first time you had any knowledge of it?

Mr. POPPER. It was formally introduced in August and my off-the-cuff recollection is that he mentioned it to us shortly before he intended to introduce it. That was the first time, certainly, that I personally had any knowledge of it, and so far as I know the first time anybody in the U.S. Government had any knowledge of it.

Mr. EDWARDS. So it is your statement that the United States had nothing to do with the drafting or the formulation or any aspect of the resolution?

Mr. POPPER. So far as the U.S. Government is concerned, I am quite convinced that is the case, Congressman. I cannot speak for individual Americans, I have no knowledge.

Mr. EDWARDS. What you are saying is that the U.S. Government officially had nothing to do with it?

Mr. POLLACK. Or unofficially.

Mr. POPPER. Either way. I am speaking for officials of the U.S. Government.

Mr. Edwards. Is it not fair to categorize the Ambassador's statement and the position, I suppose, of the State Department, that you are not immediately advocating any particular international controls of the deep ocean, but that your proposal certainly leads us in that direction at some time?

Mr. Popper. I would say, sir, that the results of the consideration in the General Assembly this fall have led to a feeling that this is a subject that deserves broad study in the international community, and if you will note the resolution that is in process of being adopted by the United Nations General Assembly, you will see that all it does provide for at this stage is a committee which, during a period of 1 year, will engage in such a study. But I think it would be going a bit too far to suggest that any preconceived solution would come out of this study. It is true that you can find a number of countries in the United Nations which would like to proceed in the direction of establishing an international organization of some kind to deal with matters involving the deep ocean floor. It is true that there are other members of the General Assembly who either have great doubts about this or who I think are quite flatly opposed to it. So I think it is premature to suggest any particular result will come out of the studies that are now underway in the United Nations.

Mr. Edwards. You do suggest somewhere in the statement, and I cannot lay my hands on it right at the moment, that one area where great caution should be displayed is the question of whether private enterprise, private technological companies or associations, would be interested in really making a full development of the ocean floor if it was set up in such a way that all of the properties or all of the proceeds and all of the benefits would go to someone on an international basis.

Mr. Pollack. It would go elsewhere.

Mr. Edwards. That is in your statement, is it not?

Mr. Pollack. Yes.

Mr. Edwards. I certainly do concur that is an area where you ought to use extreme caution because certainly this country's great progress has been built on what private enterprise has been able to accomplish and if you stifle private enterprise in that direction, I think that you will certainly retard what would be a proper development of the ocean floor.

Thank you, Mr. Chairman.

Mr. Rogers. Mr. Dow.

Mr. Dow. Mr. Pollack, it is very good to have you here with an illuminating statement. I have one question about the Pardo resolution and that is where you summarize it on page 13 on the third line, you say it looks toward a new international treaty which would reserve the ocean floor.

Does this Pardo proposal relate only to the ocean floor, that is the solid matter, or does it relate to the waters above the ocean floor?

Mr. Pollack. It relates only to the ocean floor.

Mr. Dow. I think it would pose some complications if there is a distinction between the ocean floor and the waters above that.

Could you tell us, Mr. Pollack, as to the tenor of expressions amongst the members of the General Assembly about Mr. Pardo's entire proposal? Would you say that the speeches on the subject and expressions from the different nations are generally favorable to the idea of international control of the ocean floor, or do they run in the opposite direction?

Mr. POLLACK. I will make a brief statement and ask Mr. Popper to supplement it.

I think the simplest answer is, the debate revealed no consensus of any kind with respect to the degree of control or disposition or regime for the ocean floor. There was support for practically every point of view imaginable. Will you supplement that?

Mr. POPPER. Yes, sir. What Mr. Pollack says is quite correct. I would like to point out that in such a novel field it would be surprising if, given the differing interests of different countries, you had any great consensus at the beginning, and, in fact, the statements were on all sides of this problem. There were about 47 statements.

What happens in a case like this typically in the United Nations is that they proceed rather slowly for obvious reasons, partly because many countries do not yet know what they want. I think it might be said that while we and many other countries have a fair idea of what we do not want, we have a less clear idea of exactly what we do want or what we would agree to at this stage.

In a situation like this, what has happened this time is quite typical. A resolution has been adopted in the First Committee by 93 votes in favor with one abstention, and nobody voting against it. The reason for this consensus is that the resolution proceeds very slowly indeed. It simply sets up a committee which is, as you see from Mr. Pollack's statement, asked to make a study including surveys and things of that sort and some suggestions regarding practical means to promote international cooperation in the exploration, conservation, and use of the ocean floor. So that what you will have is a committee of 35 countries which, building upon the studies already in process in the United Nations, will presumably throw up some ideas or some issues or some proposals to the General Assembly that meets a year from now. And in that Assembly, the members will be able with greater precision to tackle some of the problems that we see emerging as we talk about this subject now.

The point I would like to make is that, first, it is a very slow process. It is bound to take a year or two or three to come to grips with the problem. Second, if we follow the pattern we have used in outer space and disarmament, we will proceed by consensus, by agreement, rather than by taking votes and overriding the opposition of any considerable body of countries.

Mr. DOW. It is well known that the Soviet Government is interested in exploiting the oceans for fishing purposes and so on. Have they actually delved into the ocean floor, do you know, beyond the territorial waters of the Soviet Union?

Are they active in this area or have they manifested interest in this subject?

Mr. POLLACK. I do not believe I have run into any references of any unusual interest on the part of the Soviet Union at this point in time in going after the nonliving resources of the ocean.

Have you, Mr. Brittin?

Mr. Brittin. I have not.

Mr. Dow. Have they expressed an interest in the Pardo resolution or any opinion about it?

Mr. Pollack. Yes; they have.

Let me ask Mr. Popper to speak to that.

Mr. Popper. They are quite interested naturally, and it is striking to note that the watchword of their approach to this problem has been caution. They were quite opposed to far-reaching activities in this field. They even had doubts whether a committee should be appointed to make the study. I would say that they are very chary indeed about any international activity in the deep ocean floor area.

Mr. Keith. Will the gentleman yield?

Mr. Dow. Yes.

Mr. Keith. It would appear to me that one of the reasons they were cautious concerning international activity is because they have the capacity to do for themselves what a committee might not. It seems to me that with the tremendous fleet they have and with their customary reserve about exposing the nature and extent of their activity in science they might very well have made considerable progress in this field, which has not been revealed either to the international organizations or to others with an interest in this field. I just wondered how hard the information is that Mr. Brittin has to the effect there was very little activity of the Russians in the field of deep ocean floor research.

Mr. Pollack. I was going to say we do follow rather closely this general area, and I have seen nothing that would indicate any unusual activity on the part of the Soviet Union with respect to the ocean floor—mineral activity on the floor.

Mr. Brittin. I share Mr. Pollack's view. Collaterally I might say, Congressman Keith, this last month I spent quite a bit of time in Rome in the FAO Conference, and it happened to coincide with the time when the Pardo proposal was raised at the U.N. I do know that for those who were interested in ocean matters at that conference the Maltese proposal came pretty much as a surprise because many were asking about it. I think it indicates also possibility that this was pretty much of a unilateral move on the part of Mr. Pardo.

Mr. Pollack. Mr. Popper?

Mr. Popper. I would like to point out, Mr. Chairman, that the Soviet Union did not oppose the establishment of the committee; they voted for it. So did all of the Communist bloc. They simply were expressing what they call "the inadmissibility of any undue haste." I am quoting from their official statement in the record.

Mr. Keith. I do not want to take any more of Mr. Dow's time.

Mr. Dow. I have another question, but you proceed.

Mr. Keith. I went to Moscow in an effort to find out what they were doing in the field of oceanography, and we were, to say the least, somewhat circumscribed in our activities by the attitude of the Soviet Government. And I do recall, I believe, that we were sort of scooped in space. I suspect if we were on the space subcommittee and the State Department officials were talking to us 6 months prior to sputnik, the State Department would have told us that we were in pretty good shape, relatively speaking. I am pleased that you know that their effort and their interest is so small in the deep ocean bed.

Mr. BRITTIN. Excuse me, sir. I said I did not know. I said that nothing unusual has come to my attention.

Mr. KEITH. I thought you said there was very little evidence of their having made any real effort in the deep ocean bed.

Mr. BRITTIN. I mentioned I am not aware of any. If there is any, I do no know of it.

Mr. KEITH. Do you have reason to feel that they are not active in this area, or do you have reason to feel that they are, or do you not know?

Mr. BRITTIN. I do not know, sir, on the basis that it really is beyond my field of competence. I know in the fisheries arena they are rather good at exchanging information with us, but beyond the fisheries arena is beyond my competence.

Mr. KEITH. I just did not want the committee to get the impression from the testimony which was offered that they were not really actively pursuing this. We just do not know. I think the Congress should bear this in mind.

Mr. KARTH. Does anyone in the State Department know the answer?

Mr. POLLACK. I think I indicated, sir, in my previous statement that we do follow all the available information on the oceanographic programs, not only in the Soviet Union, but in other countries. The principal thrust of the oceanographic program in the Soviet Union has been directly toward the living resources and toward the scientific acquisition of oceanographic information, topography, and so on. Nothing has come to my attention which would indicate anything approximating an equal concern or investment of resources with respect to the ocean floors and their mineral resources.

Mr. KEITH. Thank you.

Mr. DOW. Just to continue along that line, I recollect recently seeing a brochure which demonstrates the Soviet activities in oceanography and they are very active in that field. And from what little knowledge I have of our own activity in that field, oceanographic exploration generally goes to the extent of taking cores, coring samples in the deep ocean.

I rather remember that in the Russian bulletin on their activity there was a picture of cores there. I could be mistaken, but there was some evidence. I do not think from that evidence we could measure it, but I would be rather surprised if they had not manifested some action and activity in that field.

Mr. POLLACK. I did not mean to imply they have not because indeed they have. They are a major oceanographic power at this point in time and they are proceeding along all of the lines that would be appropriate to a major oceanographic power. I was simply trying to indicate that I do not know of any information that would indicate that their posture in the UN was related to some major technological achievement which they are about to spring on the world relating to the ocean bottom.

Mr. DOW. In other words, you do not think they are taking millions of barrels of oil out of the Pacific Ocean floor or anything of that kind?

Mr. Pollack. No; I do not.

Mr. Dow. I had one more question, Mr. Chairman, and that is, during the pendency of this study and report that seems to be under way in the U.N. is there any moratorium on activity by individuals or countries on the deep ocean floor? Is there anything that would prevent activity or extension of activity to a greater extent by the U.S. interests or any other interests?

Mr. Pollack. No, sir.

Mr. Dow. Thank you, Mr. Chairman.

Mr. Lennon. The gentleman from California, Mr. Reinecke?

Mr. Reinecke. Gentlemen, I am concerned a little about the statement on page 14, which is a rephrasing of Mr. Goldberg's statement. You say he pointed out that the deep ocean floor should not become a stage for competing national sovereignties, but, rather, should be open to exploration and use by all states, without discrimination. Can we not pretty well conclude from that that we agree with the Pardo resolution, at least in philosophy, and further that we are saying in effect, yes, we agree but we do not have the mechanics at the time to agree with the details?

Mr. Pollack. No. First of all, sir, we did not intend in any way whatsoever, in our version here, to alter the sense of what Ambassador Goldberg stated. He in turn was providing an interpretation of President Johnson's statement on the occasion of the commissioning of the *Oceanographer* in which the President stated:

> Under no circumstances, we believe, must we ever allow the prospects of rich harvest and mineral wealth to create a new form of colonial competition among the maritime nations. We must be careful to avoid a race to grab and to hold the lands under the high seas. We must ensure that the deep seas and the ocean bottoms are, and remain, the legacy of all human beings.

Ambassador Goldberg, referring to that statement, said:

> This means, in our view, that the deep ocean floor should not be a stage for competing claims of national sovereignty. Whatever legal regime for the use of the deep ocean floor may eventually be agreed upon, it should ensure that the deep ocean floor will be open to exploration and use by all states, without discrimination.

I think the thrust of Mr. Pardo's proposal went far beyond that.

Mr. Reinecke. I realize mechanically it did, but I think we have substantially agreed the deep ocean floor, if it is not to become a matter of national sovereignty, it becomes a matter of international sovereignty.

Mr. Pollack. I suppose that if you do not have national sovereignty one thing you could conceivably have would be international sovereignty.

Mr. Reinecke. So we agree in effect with the Pardo resolution and so has the President?

Mr. Pollack. We have not yet reached any conclusion. I do not think we are yet satisfied where the merits lie as to the ground rules that ought to apply to the advance by the countries of the world in the ocean bottoms and the extraction of the resources that lie there.

Mr. Reinecke. Have you eliminated the national sovereignty?

Mr. Pollack. I think there is a point beyond which the Continental Shelf does not go. This is known as the deep ocean floor, and I think our statement says national sovereignty would not be an appropriate way to dispose of that area.

Mr. REINECKE. In your statement, again on page 14, you indicate that the deep ocean floor should be open to exploration. Did the Goldberg statement include exploitation?

Mr. POLLACK. No, it said "exploration and use."

Mr. REINECKE. Does use include the military? Or is it a general term?

Mr. POLLACK. Use is a very general term.

Mr. REINECKE. Are we not setting the stage, 5 or 10 years away, where we will not be able to put military installations on the deep ocean floor?

Mr. POLLACK. No. I interpret the statement to mean it would be open to use.

Mr. REINECKE. But would we be a national sovereignty looking for our own interests?

Mr. POLLACK. I do not think it has been said by Ambassador Goldberg or by anyone in the executive branch that there will not be national use made of the ocean floor, just as there is now national use made of the seas above the ocean floor.

Mr. REINECKE. On page 16 you indicate the general attitudes range from an apparent willingness by some to act now to adopt several of the principles suggested by Ambassador Pardo to a reluctance on the part of others to have the General Assembly involve itself in these issues or to create a special committee to consider them seriously. Can you give us examples of some of the countries that are reluctant to have the General Assembly involve itself in these issues?

Mr. POLLACK. Let me ask Mr. Popper to reply to that.

Mr. POPPER. I mentioned, Mr. Chairman, the Soviet Union as one of the group of countries that was very reluctant to go very far. I think some of the countries of Western Europe were also reluctant to go very far, although they did eventually agree to the terms of the resolution passed by the Political Committee of the General Assembly.

On the other side, many of the developing countries, and some countries which took a position sympathetic to theirs, looked at the Pardo proposal as something very desirable. Some of those countries might be said to be Malta, Pakistan, Kenya, and Somali, to take a few, and the delegation of Sweden indicated sympathy with their view.

A third group of countries are those which are concerned about jurisdictional problems extending beyond the shoreline. Certain Latin American countries, which claim a 200-mile zone are, I understand, cautious about where this might lead them. All of these matters were discussed in the Political Committee.

Mr. REINECKE. I think you said 47 countries have made statements?

Mr. POPPER. Yes.

Mr. REINECKE. Is it asking too much to provide to the committee a list of those countries?

Mr. POPPER. Not at all. We could give you something of that kind, yes indeed.

Mr. REINECKE. I would appreciate that, Mr. Chairman.

Mr. LENNON. Very well.

(The list of countries follows:)

U.N. DEBATE ON USE OF THE OCEAN FLOOR

The following countries, listed in the order in which they spoke, addressed the questions raised by the First Committee of the General Assembly by the Maltese item dealing with the ocean floor:

Malta
United Kingdom
United States of America
Venezuela
Ireland
U.S.S.R.
Norway
Netherlands
Republic of China
Libya
Somalia
France
Nigeria
Chile
Ghana
Poland
Trinidad and Tobago
Ceylon
Honduras
Brazil
Austria
Sweden
Tanzania
Colombia
Iceland
Sierra Leone
Italy
Liberia
Ecuador
Turkey
United Arab Republic
Madagascar
Afghanistan
Greece
Tunisia
Belgium
Bulgaria
Mexico
Australia
Peru
Japan
Yugoslavia
Canada
Jamaica
Iran
India
Cyprus
Boliva
Thailand
El Salvador
Argentina
Romania
Indonesia
Philippines
Byelorussian SSR
Finland
Hungary
Czechoslovakia

(The provisional verbatim records of the debate in the General Assembly are attached for the files of the Committee.)

Mr. Reinecke. Could you tell me what position France took on this particular question?

Mr. Popper. They were on the cautious side, as I recall it. The French and the Belgians wanted a very restricted mandate, something along the line we now have in the resolution.

Mr. Reinecke. And you mentioned one country abstained.

Mr. Popper. That was Gabon, and we doubt that the representative of Gabon could have abstained on any substantive ground. He may have been cautious.

Mr. Reinecke. What was the actual vote?

Mr. Popper. Ninety-three in favor, one abstention, and none against. This was in committee. This will probably go before the full Assembly in the next few days and then it will be a resolution of the General Assembly.

Mr. Reinecke. There were no negative votes?

Mr. Popper. There were no negative votes.

Mr. Reinecke. Which of the three categories would you put the United States in?

Mr. Popper. I think you would put the United States in the cautious category. We certainly were not able to sign on to all of the specifics of the Maltese proposal. I think we stated we did not think the time had come to deal with the basic objectives of the proposal.

Mr. Reinecke. On page 17 you indicated that there were suggestions that there be no unilateral exploitation of the resources of the deep ocean floor. Which country made that suggestion?

Mr. Popper. There were several who did. I would have to look that up.

Mr. Reinecke. Will you place that in the record, please?

Mr. Popper. Yes.

(The information follows:)

Countries Suggesting No Unilateral Exploitation of the Ocean Floor

Those countries which, during the debate in the General Assembly on the Maltese item, advocated a moratorium on unilateral exploitation of resources of the ocean floor are (in alphabetical order):

Ceylon
Finland
Libya
Malta
Somalia
Sweden
Thailand

Mr. Reinecke. Then, regarding the ad hoc committee, I think we discussed this before. Do you feel 1 year is an adequate period of time to accomplish any results on this proposal?

Mr. Pollack. You are talking about the ad hoc committee in the United Nations?

Mr. Reinecke. Yes.

Mr. Popper. I would say that 1 year is not enough, and I think it would be premature to expect that this committee will come up with firm answers 1 year from now. The whole timetable to which it is geared would preclude that. The Secretary General is making a study which started last year and which is to be concluded next spring. This committee will barely be able to conclude its work by next September.

Mr. Reinecke. If 1 year is not going to give us the answers, I hope we will not go ahead and start generating frameworks based on incomplete data.

Mr. Popper. I am sure we would not be guilty of undue haste. We would proceed at a deliberate pace. Just as it took 8 or 9 years to get to an outer space treaty, I think it would take several years before the United States could decide whether it would want to assume a binding commitment.

Mr. Reinecke. Thank you, Mr. Chairman.

Mr. Lennon. The gentleman from Florida.

Mr. Rogers. What do you consider the present law to be governing beyond 200 meters offshore?

Mr. Futterman. You mentioned 200 meters, which is the minimum figure specified in the Convention on the Continental Shelf. The Contenental Shelf is there defined "as referring (a) to the seabed and subsoil of the submarine areas adjacent to the coast but outside the area of the territorial sea, to a depth of 200 meters or, beyond that limit, to where the depth of the superjacent waters admit of the exploitation of the natural resources of the said areas; (b) to the seabed and subsoil of similar submarine areas adjacent to the coasts or islands."

So 200 meters is the minimum depth. The key word, often overlooked, is "adjacent" to the coast, and I think that is what Congressman Pelly was referring to. It is not clear just to what distance an area beyond the coast could be considered to be adjacent.

Mr. Rogers. What is the position of our Government?

Mr. Futterman. We have not taken a position on the exact meaning of the word "adjacent."

Mr. Rogers. Is it so difficult?

Mr. Futterman. It is, sir.

Mr. Rogers. In line with the qualifying terms? Is this causing difficulty with you?

Mr. Futterman. Well, as Ambassador Goldberg's statement indicated, and as Mr. Pollack has explained, we have taken the position that the Continental Shelf does not extend to the mid point of the ocean and that the oceans, so far as the floor is concerned, are not national lakes. And, as indicated, the Convention on the Continental Shelf specifies 200 meters as the minimum depth. Our problem now is trying to determine what further definition there should be between 200 meters and mid point of the ocean.

Mr. Rogers. I am not talking about that. I am sticking to the Geneva Conference saying adjacent to the coast shall be exploitable. Can we go out to a depth of 4,000 feet?

Mr. Futterman. I think that may depend to some extent on how many miles it takes you from shore.

Mr. Rogers. Suppose it is still off our coast but it is 4,000 feet deep?

Mr. Futterman. It might be 1,000 miles or only 10 miles off our coast. The question of exploitability is not the only requirement.

Mr. Rogers. Nor is adjacency.

Mr. Futterman. Nor is adjacency the only requirement, but those are two of the requirements.

Mr. Rogers. Certainly, but you seem to want to split them. So there is no way to tell what the governmental position is so far as the State Department is concerned?

Mr. Futterman. There is no governmental position on precisely where we would consider the Continental Shelf to end.

Mr. Rogers. Why should we move in an international body until we know what our position is under the present law?

Mr. Pollack. We did not move into an international body. The initiative was taken by someone else.

Mr. Rogers. You say the U.S. Government really started this whole movement, according to your statement on page 11:

> You may recall that, under U.S. leadership, the Economic and Social Council of the United Nations had asked the U.N. Secretary General in mid-1966 to make a survey of the current state of knowledge of the resources of the sea beyond the continental shelf, excluding fish, and of the techniques for exploiting them. Building on this foundation, the U.N. General Assembly a year ago asked the Secretary General to broaden this study, so as to survey also the activities of member States and intergovernmental organizations in this field and to formulate proposals for insuring the most effective arrangements for an expanded program of international cooperation. The Secretary General was directed to report to the U.N. General Assembly next fall.

Then it is from that foundation that our own Government has started in movement the Pardo resolution. It seems to me State has taken on itself a rather formidable task of injecting us into the international field before the Government has made up its mind where we stand under existing law and existing international treaties. We do not even have a position on how far we can go out.

Mr. Pollack. The U.N. resolutions that called for the studies that you quoted from my statement were introduced, essentially, because this is a problem that was predictable and has been predictable for some years. The advance of our technology in this field has been moving faster than was anticipated when the Conventions were drafted in 1958. Our position in 1966 and our position today remains the same, that we need to know a great deal more about the nature of that environment and what will be required to work in it before we or any other nation can intelligently come to any conclusion as to the nature of the regime.

Mr. Rogers. You jumped into the international field before you decided where we stand under present law.

Mr. Pollack. All we have jumped into in these two resolutions was a scientific inquiry as to the state of our knowledge.

Mr. Rogers. You just voted to have a study made of the Malta situation?

Mr. Pollack. Yes.

Mr. Rogers. You had Ambassador Goldberg do it. You did not have a directive from Congress to do it, and yet you cannot tell me how far an American company can go out and exploit the bottom of the sea under present law and under the Geneva Conference.

Mr. Pollack. I think in this respect the situation is comparable to the situation in outer space. Until you achieve the capability to deal in outer space there is no reason to have a law. This was previously the case with respect to the deep ocean floor, but we are rapidly reaching the point where this will no longer be the case.

Mr. Rogers. The point I am making is that this Nation has a capability of exploiting, probably more than any other nation including Russia, the deep ocean bottom.

Mr. Pollack. Yes, sir.

Mr. Rogers. And instead of proceeding under the present law and the Geneva Conference to bring a benefit to this Nation, you are ready to push this into the U.N. before we know how far a company can go out to exploit for the benefit of our own people?

Mr. Pollack. I am not sure which definition would benefit most our industry and economy. There is a definition that can be made—and I do not know what the consequence would be——

Mr. Rogers. I think if an effort were made to gather our scientific knowledge—Congress set up a national council and commission to go into this and answer some questions, but instead of waiting in 1966 you hopped into the U.N. before a national policy was established. You set up an ad hoc committee that is determining national policy instead of the Congress.. The State Department has jumped us into the U.N. and you do not have enough knowledge yet because our commissions have not reported, nor have the scientific groups made their report. And you cannot even tell us how far present law will let us go.

Mr. Pollack. The absence of adequate knowledge is a subject on which I think we are in complete agreement. I do not think it is yet clear whether the interests of the American industrial concerns will be best served by having the nations of the world lay claim to large areas off their shelves which they would then be in a position to deny to our industrial interests. I do not know where the merits lie on that question.

I repeat that the actions taken at the U.N. were a part of a basic thrust of trying to gain an understanding. We are not the only country in the world that has been following the ocean floor with a great deal of interest. Malta has been trying for some time to make oceanography a center of its economy. We are not in a position to deny to any country the right to introduce a proposal and have it considered by the U.N.

Mr. Rogers. Of course we are not, but we did not have to instigate it when the State Department has not even taken a position as to what is permitted under present law. Also, I am not so sure that other departments of Government are in agreement with this nebulous no-man's land or unknowing position on ownership. The Department of the Interior, I understand, has leased land off the west coast to depths of 4,000 feet. So I do not know but what the State Department is putting us in a strange position, where the United States is leasing land and you are telling us we do not even own it. Is that true?

Mr. Lennon. If the gentleman will yield, let us get into the record the date of the introduction of the so-called Pardo resolution. As I recall it, it was in 1966 in the late summer or early fall.

Mr. Popper. The request to include the Maltese item on the agenda was contained in a letter dated August 17 and circulated by the Secretary General on August 18 of this year.

Mr. Lennon. Of this year?

Mr. Popper. Yes.

Mr. Lennon. I ask that question because there was some suggestion made by Mr. Goldberg last summer in anticipation of what was to be the so-called Malta-Pardo resolution. I think that was discussed in a meeting I attended earlier this year.

Mr. Rogers. The point I was making was the United States in mid-1966 asked for a study and activity in this whole field, and as a consequence I think the Pardo-Malta resolution followed that.

Let me ask you this: I will not pursue this ownership because I do not think anybody in State knows the answer. How do you come to a decision in the State Department on an official position? Is it from this ad hoc committee or the actions of Congress or the National Council?

Mr. Pollack. I think it is all of these, including consultations with experts from industry and our universities and certainly the very large participation of the agencies of Government that have responsibilities in the ocean, such as the Navy and Interior Departments.

Mr. Rogers. Who initiated this mid-1966 movement? I do not think the Council initiated it. There was no request from Congress for it. How did this ever get started?

Mr. Pollack. I would have to reconstruct.

Mr. Rogers. I would be very much interested in how we can jump into something like this without even knowing what the present law is.

Mr. Pollack. I think Ambassador Roosevelt was our representative at that time.

Mr. Rogers. As a matter of fact, I think he introduced it.

This causes me great concern. I would hope the State Department would reexamine its procedures and perhaps consult more with the Congress in these matters. I would like if you could furnish for the record how far we can go. What does present law permit U.S. interests to do now and why are we not expanding on this rather than going into some other field before we know where we are under present law?

(The requested information follows:)

BACKGROUND ON ECOSOC RESOLUTION 1112 (XL)

In accordance with instructions from the Department of State, Ambassador James Roosevelt on February 28, 1966 proposed at the 40th session of the United Nations Economic and Social Council in New York that the United Nations Secretary General make a study of the present state of knowledge of the resources of the sea and of the techniques for exploiting these resources. As a part of that study, there would be an identification of offshore resources now capable of economic exploitation and the identification of gaps in available knowledge which merit early attention by virtue of their importance for the development and exploitation of ocean resources.

Resolution 1112 (XL) as adopted on March 7, 1966 was along these lines, specifically limited, however, to the sea beyond the continental shelf and excluding fish.

Mr. ROGERS. Thank you, Mr. Chairman.

Mr. LENNON. The gentleman from Massachusetts?

Mr. KEITH. What is the classic definition of foreign policy? Can you define in one sentence what foreign policy is for any nation?

Mr. POLLACK. Foreign policy, I think, would be described as those objectives which a country has with respect to its relations with other countries. The objective might be peace, it might be enlarged commercial relationships, etc.

Mr. KEITH. And what are the tools of that foreign policy?

Mr. POLLACK. I think the customary response to that is, the tools start out with the strength of a country, its geographic location, its military strength. At this point of time certainly the U.S. technological capacity and the way we use it in our international relations is a tool of foreign policy. Our cultural activities and capacities are another tool.

Mr. KEITH. And these tools are used to accomplish peace and the other objectives?

Mr. POLLACK. Yes.

Mr. KEITH. What is our relative strength in the field of oceanography as contrasted to the rest of the nations of the world?

Mr. POLLACK. Our scientific capacity, I think, is without peer. This may be a slight exaggeration. On the fisheries side we are excelled by several countries.

Mr. KEITH. What part of the cost of the operation of the U.N. does the United States contribute?

Mr. POPPER. Thirty-one percent plus, between 31 and 32 percent of the regular U.N. budget.

Mr. KEITH. And in the field of oceanography would we not, by reason of our expertise and our resources in that field, be making the major contribution to this study and then making it available, in effect, to the international organization?

Mr. POPPER. Yes.

Mr. KEITH. The point I am trying to get at is that we are the ones who can finance it and are financing it, we have the techniques, and this is a tool of our foreign policy, and if we vitiate it by giving it to the U.N. organization we may lose some of the bargaining tools we have. It seems to me the point Mr. Rogers has been trying to develop here indicates we really did not recognize where we are and what we have to work with before we took this attitude and encouraged the international approach, and we may be weakening one of the wedges we have to help us in our relationships with other powers who have other things to trade off.

Mr. POLLACK. Sir, I do not think there is anything presently contemplated which would involve concessions with regard to our technological ability.

Mr. KEITH. Of course, I do not want to pursue this too much further at this time. I support the international efforts made in this field, but I do not see that our current relations with other major powers give us much reassurance that we are going to be able to further our foreign policy in other areas by our sharing the initiative to the extent contemplated in the Malta resolution and, to a lesser degree, in the study we have undertaken.

Are you acquainted with the State Department effort with regard to *Torrey Canyon*?

Mr. POLLACK. Yes.

Mr. KEITH. What is the current status of the IMCO study of the whole question of international regulation over trade routes?

Mr. POLLACK. I should have anticipated that question and I apologize that I do not have in mind the current status of the IMCO activities on that subject. I will be glad to supply that for the record.

Mr. KEITH. You are aware of the fact this committee has a bill dealing with the subject to some extent?

Mr. POLLACK. Yes.

Mr. KEITH. And the President has asked that further studies be expedited so that we can avert such a problem in the future.

Mr. POLLACK. Yes, sir.

Mr. KEITH. I think it would be helpful if you could place in the record a statement of where the IMCO negotiations and studies stand at the moment.

Mr. LENNON. That can be included in the record.

Mr. POLLACK. I will be glad to do that, Mr. Chairman.

(The information follows:)

CURRENT STATUS OF IMCO STUDIES (PREVENTION OF OIL POLLUTION)

In May 1967, following the *Torrey Canyon* incident, the IMCO Council met in a special session and organized a program to consider measures that might be taken to avoid such disasters in future.

Several subcommittees have been working on this program on an urgent basis. The Subcommittee on Safety of Navigation met in July and again in December and has proposed amendments to the Convention for Safety of Life at Sea and additional recommendations to governments intended to improve navigation and avoid accidents and resultant pollution. The Subcommittee on Oil Pollution met in September and is meeting again in January. It has not yet reported, but is expected to recommend amendments to the Convention for the Prevention of Pollution of the Sea by Oil to tighten the provisions of the convention with respect to oil discharge and enforcement. The Subcommittee on Ship Design and Equipment met in January to consider any new rules that may be needed in its area of competence. It has not yet reported.

The reports of these subcommittees will be considered by IMCO's principal technical body, the Maritime Safety Committee, at its next meeting March 11–15. Assuming the Committee approves, proposed amendments to the Safety Convention and the Oil Pollution Convention will then be sent to the member governments, along with other recommendations, prior to consideration at an extraordinary session of the IMCO Assembly, which has been scheduled for this purpose in the fall of 1968. This Assembly session, which will wind up the first phase of the program, could not be scheduled earlier since both conventions require that proposed amendments be submitted to the governments at least six months before the Assembly.

In addition to the technical subcommittees, a newly-formed IMCO Legal Committee has been actively studying legal aspects of the problem. The Committee and two of its working groups met in June, September, and November, and are scheduled for further meetings in April and June. If the Legal Committee has any recommendations ready by the time of the extraordinary Assembly they will be considered along with the rest of the package, but it appears likely that the main part of this group's work will have to be completed at a later date.

Mr. KEITH. One of my staff advises me that the Subcommittee on Safety of Navigation and Oil Pollution has submitted their report to IMCO, three more reports are due and the State Department does have those reports. So if we could have a confirmation of that.

Mr. LENNON. The U.S. delegation to the UN, headed by Mr. Goldberg, were the cosponsors of the seabed resolution and in effect created the ad hoc committee.

Mr. POLLACK. Yes, sir.

Mr. LENNON. I have a copy of a statement here made by Mr. Goldberg in which he states that his delegation are sponsors of this resolution. I also have a draft resolution on seabeds. Was that resolution adopted or was it tabled?

Mr. POLLACK. May I ask Mr. Popper to respond to that?

Mr. LENNON. This resolution was cosponsored by the U.S. delegation headed by Mr. Goldberg. Was it adopted or was it tabled?

Mr. POPPER. The resolution which we cosponsored along with 43 other countries has been adopted by the Political Committee of the General Assembly. Final adoption should take place in a few days.

Mr. LENNON. I would appreciate it if you would look at this and tell us what you mean by this resolution dated December 7, 1967, and it is the same date, December 7, 1967, as the statement in explanation of the resolution on seabeds.

Mr. POPPER. What happened was this: A number of countries produced draft resolutions. A working group was appointed to winnow out the drafts. Some 40 countries participated and at one time they had a drafting group of six. The result was the draft resolution in your hand.

The word "tabled" in the UN means introduced. It is not used in the congressional sense at all.

Mr. LENNON. In Mr. Goldberg's statement, I notice he said his delegation had proposed that the Assembly take a step more substantial than the creation of the ad hoc committee. He does not explain just what "more substantial" step the U.S. delegation wants to take, but he makes it crystal clear they should do something more because he says that the result of the ad hoc committee will be to inform the General Assembly on this question, and on the basis of that information he believes the General Assembly may well wish to establish a committee on the oceans. So I would assume the original position of the U.S. delegation was that it wanted to move on the creation of a committee on the oceans and this was the initial step. Is that a fair conclusion?

Mr. Popper. First let me say that the statement of December 7 was not personally given by Ambassador Goldberg but by a member of his delegation.

Mr. Lennon. He was the head of the delegation?

Mr. Popper. Yes. The statement you paraphrased refers to the part of Ambassador Goldberg's statement of November 8 in which he said that the U.S. delegation proposed that the General Assembly take action at this session of the Assembly to establish a Committee on the Oceans. The thought was to have a permanent committee. The one finally appointed has a mandate of only 1 year. Then it makes a report and leaves it to the General Assembly to decide at that time whether it wishes to proceed to something more permanent.

Mr. Lennon. I think most of us in Congress are concerned with respect to the authority, if any, or the jurisdiction, if any, which we have as to certain depths on the west coast or the east coast. I am reminded that there is a reef or bank, called the Cortez Bank, 100 miles off the State of California where there is a depth of 15 feet and a private company wanted to build an island and the Department of the Interior said "No," that this country did not have jurisdiction. Do you gentlemen know about that?

Mr. Futterman. I believe I know the case to which you are referring. I think in that case some private individuals were interested in putting some fill on the reef and establishing an island. I do not believe they applied to the Department of the Interior or any other Government agency to do that. That was the cause of the controversy. I believe there was talk about possible litigation by the U.S. Government if they proceeded.

Mr. Lennon. If the Government can exercise no jurisdiction to the extent of 100 miles off the shores of California how can the Federal Government say "No" to any individual if they want to invest in a man-made island?

Mr. Futterman. The basis on which the Federal Government would do that would be on the ground that this was covered by the Outer Continental Shelf Lands Act. All these cases have been considered on their own merits and on a case-by-case basis. The Interior Department has indeed leased parcels of land that at least in part lay deeper than 200 meters. However, there is no broad general rule that can be extrapolated from these cases.

Mr. Lennon. I am reminded that somewhere south of Newfoundland there is an island owned by France or Canada.

Mr. Futterman. Miquelon Island?

Mr. Lennon. Yes.

Mr. Futterman. France.

Mr. Lennon. They recently leased quite a substantial area of ocean floor for exploitation in that area, have they not, involving both Canada and France.

Mr. Futterman. I am not familiar with this.

Mr. Lennon. The news media carried the story just this week about that. The question that arose was what was the authority to do that and how far does France have authority to lease for exploitation? I understand this is relatively shallow water and the depth does not enter into it. However, I thought the distance did enter into it.

I think this is a very complex subject. There is no question about it.

I believe that the mood of America is, rightly or wrongly, reflected in some of the things that have been said here by several members of the committee with respect to protecting our own interests first.

I know in discussing it individually with some members of the Presidential Commission who are business people they like the Prado resolution. I think big business perhaps can do better business with perhaps one central organization for exploitation of minerals and oils particularly.

This is a really complex subject, gentlemen. We appreciate your attendance here this morning and your willingness to talk frankly about some of these problems which are involved.

We look forward to having the opportunity of hearing you again next year so we can follow this up.

I had a series of questions I wanted to ask but I have word we are supposed to be on the floor very shortly. We will have to wish you a Merry Christmas and look forward to next year.

Mr. POLLACK. Thank you very much, Mr. Chairman.

(Whereupon, at 12:20 p.m., the committee adjourned.)

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